# Radio and Electrical Review

OUR COVER:

In the background can be seen some microwave aerials situated on top of the Casino building at Cassel near the French coast. These were used to relay television programmes to and from Swingate, near Dover, during the week of programme exchanges between Britain and seven other nations, which has been termed "Eurovision." A short article appears on page 32.

●

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio and Electrical Traders' Federation.
N.Z. Radio, TV and Electrical Assn. (Inc.).

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Advertising Manageress:
Miss D. JAMIESON

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
All correspondence and contributions should be addressed to:

The Editor,
"Radio and Electrical Review,"
P.O. Box 8022,
Wellington, N.Z.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.), Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., 28 New Bridge Street, London, E.C.4.
Telephone City 5118.
Cables: Cowlawads Cent, London.

VOL. 9, No. 7 1st SEPTEMBER, 1954

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*Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington*

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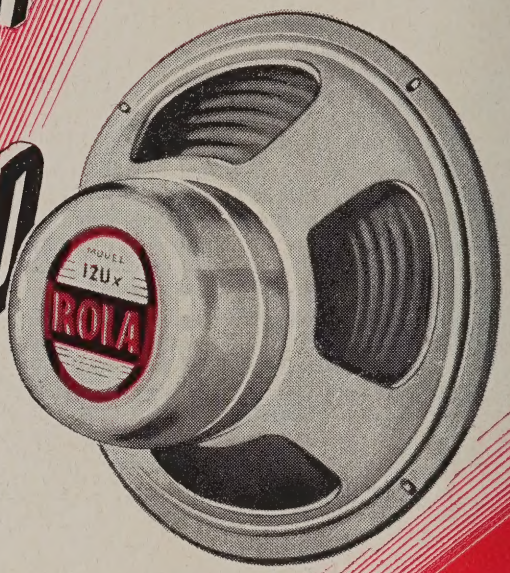
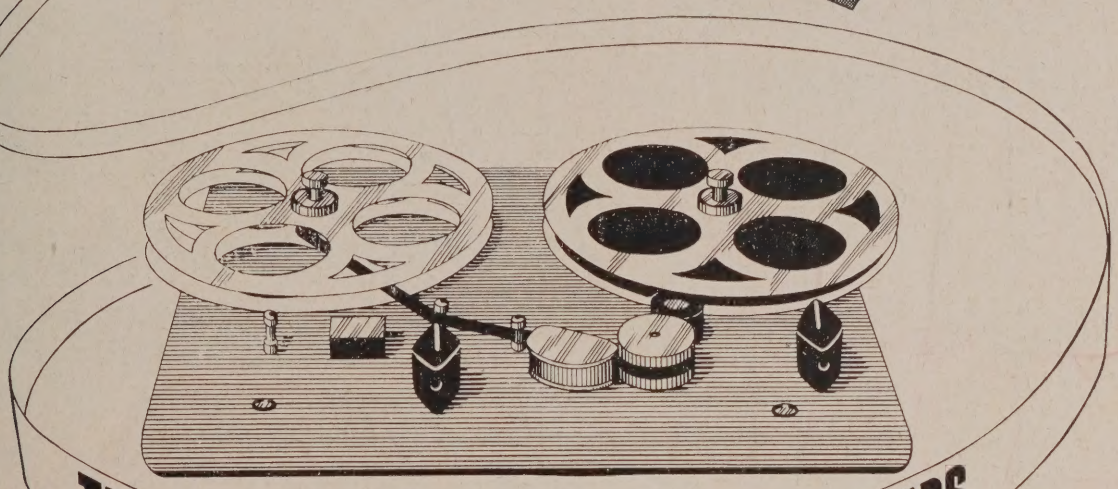
# SPOTLIGHT ON SOUND




## *Specifications*

| | |
|---|---|
| Power Handling Capacity | 12 watts (Peak) |
| Fundamental Diaphragm Resonance | 50 c.p.s. ± 5 c.p.s. |
| Frequency Response | 45-12,000 c.p.s. |
| Voice Coil Impedance at 400 c.p.s. | 8.4 ohms. |
| Air Gap Flux Density | 13,000 Gausses |
| Total Flux | 278,000 Lines |

# Qualitape



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**SPOOL SPINDLES:** Of high-quality steel, revolving on solid gunmetal brackets on ball-bearing centres.

**TAPE GUIDES:** Finished in chromium.

**MAGNETIC ERASE HEAD:** Designed exclusively for Tape Recorder use.

**RECORD/PLAYBACK HEAD:** Low impedance; circular mumetal stacks of 0.008 thick laminations; built up to ¼ in.; wound to close tolerance and set in rubber with outer case finished in chromium.

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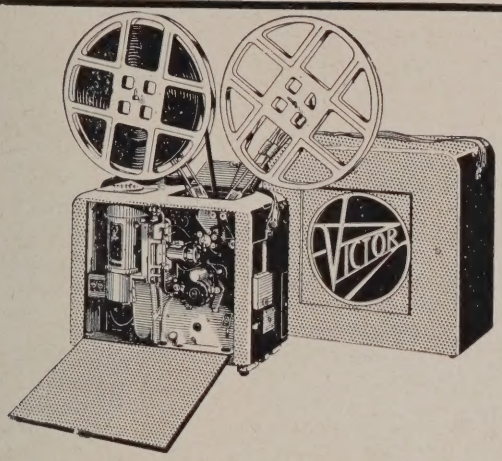


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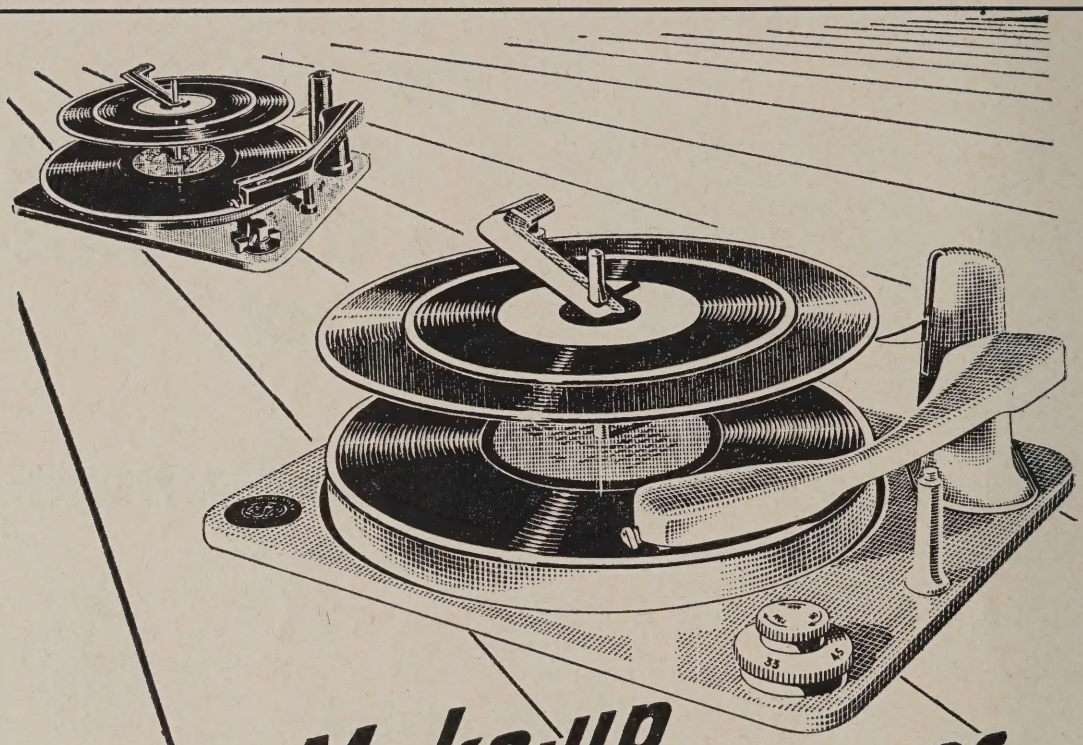

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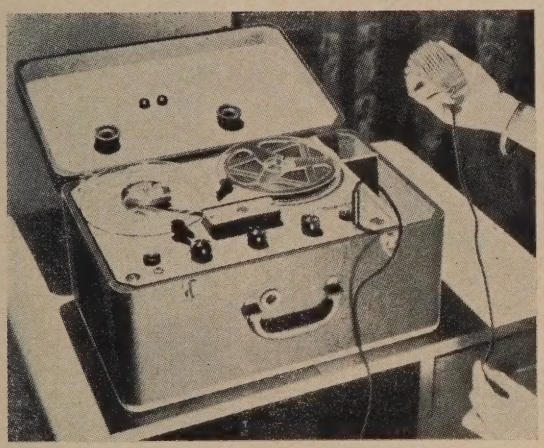

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| Standard stylii | | 7 | 9 |
| L.P. stylii | | 8 | 1 |
| Garrard Hi-Fi. stylii | | 12 | 6 |
| Ronette T.O. Cartridges | 2 | 2 | 6 |
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| L.P. stylii | | 8 | 6 |
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| B.S.R. Monarch cartridge | 2 | 11 | 3 |
| Standard stylii | | 10 | 9 |
| L.P. stylii | | 10 | 9 |
| Decca standard stylii | | 13 | 4 |
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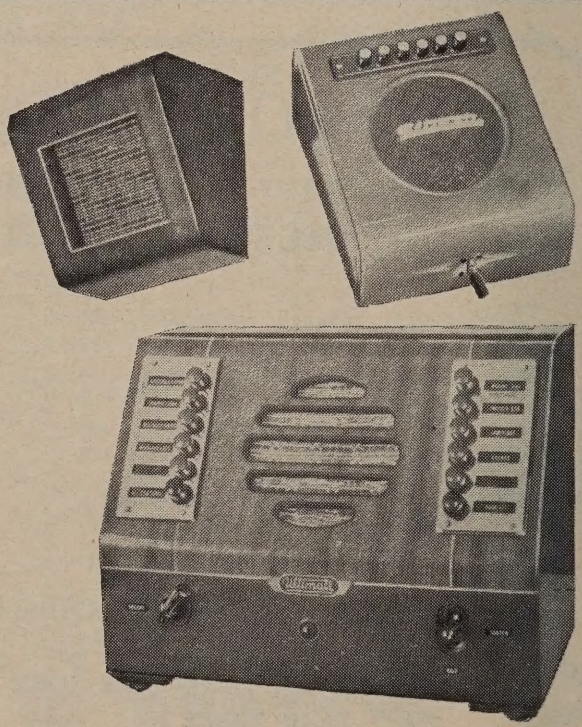

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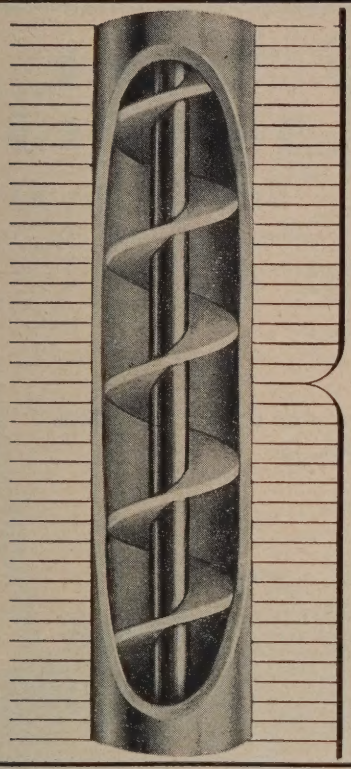

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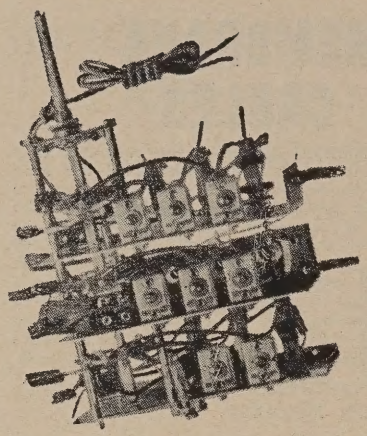

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*Fitted to sturdy 8/9 valve, plated steel chassis.*
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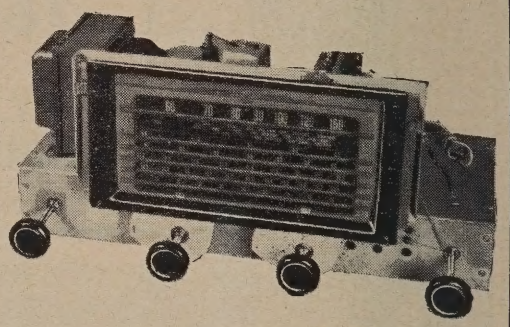

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No. 20

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The value of current which heats a winding is known as the R.M.S. current. The current which charges a battery is best expressed as the average value. In an alternating current wave form the average value and R.M.S. value of current are not the same.

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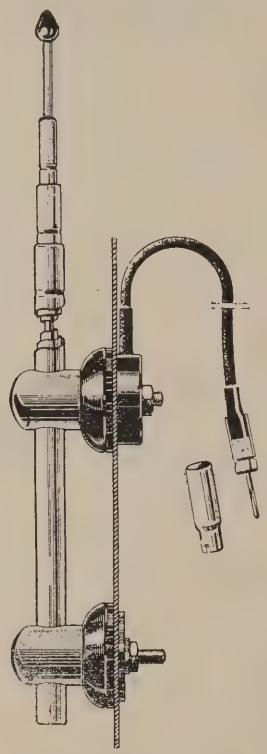

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| 4 section side mounting | 4 section wing mounting |
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| extended 100 in. | extended 78 in. |
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Features common to UA/SPT-4 and UA/SA-4 MP. aerials are:

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- Long phosphor bronze contacts.
- Well-designed adjustable insulators.
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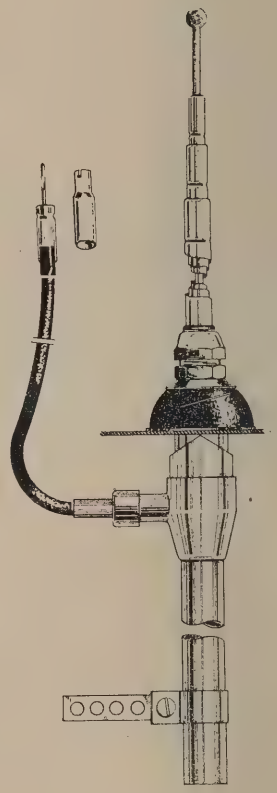

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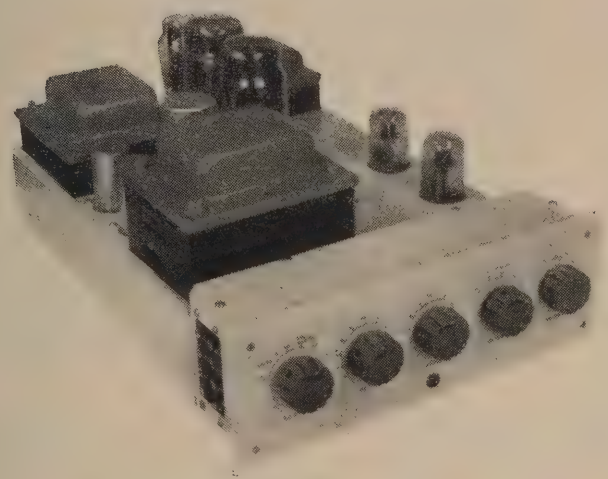

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**Power Output:** 12 watts; 15 watts peak.

**Output Transformer Tappings:** 3.75, 6.6, 15, and 60 ohms impedance.

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**Distortion:** Less than 0.1 per cent.

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**Negative Feedback:** 26 db.

**Sensitivity:** 0.4 volts for 12 watts output.

**Valves:** 2 KT66 (Osram), 1 ECC33 (Mullard), 1 ECC35 (Mullard), 1 GZ32 (Mullard). American equivalents: 6L6, 6SN7, 6SL7, and 5V4.

**Mains Input.** 100 to 150 volts and 200 to 250 volts A.C. 50/60 c/s.

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**Power Required;** 6.3V. 1.3A. and 450V. 4.0mA. H.T., derived from PF 91.

**Sensitivity:** From 3 to 120 millivolt, depending on input facility used for 0.5-volt output.

**Noise and Hum:** Approximately — 60db. on 0.5 volts.

**Valves: 2 ECC40 (Mullard) no known** equivalent.

Controls:

(a) **Selector** (six positions): (1) radio/tape; (2) crystal pick-up; (3) magnetic pick-up with compensation for Standard British (78 r.p.m.) records; (4) magnetic pick-up with compensation for N.A.B. records; (5) magnetic pick-up with compensation for L.P. records; (6) microphone.

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# LESA

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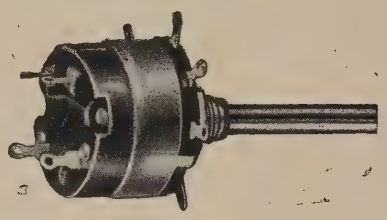

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And while you are comparing these, look at the construction. Note that there are no intermediate drive wheels employed and no belts to slip or to replace. Rotate the turntable and observe how freely it spins. This is the combined result of dynamic balance and ball-bearing suspension. Now lift the turntable. It's heavy . . . intentionally weighted to give flywheel action for constant, steady rotation. You'll notice that the turntable is rubber covered. Important . . . because unlike other materials in use this surface does not shed; and dust and grit particles cannot become imbedded. On the underside is a 4-pole motor with self-aligning oilite bearings for silent steady power.

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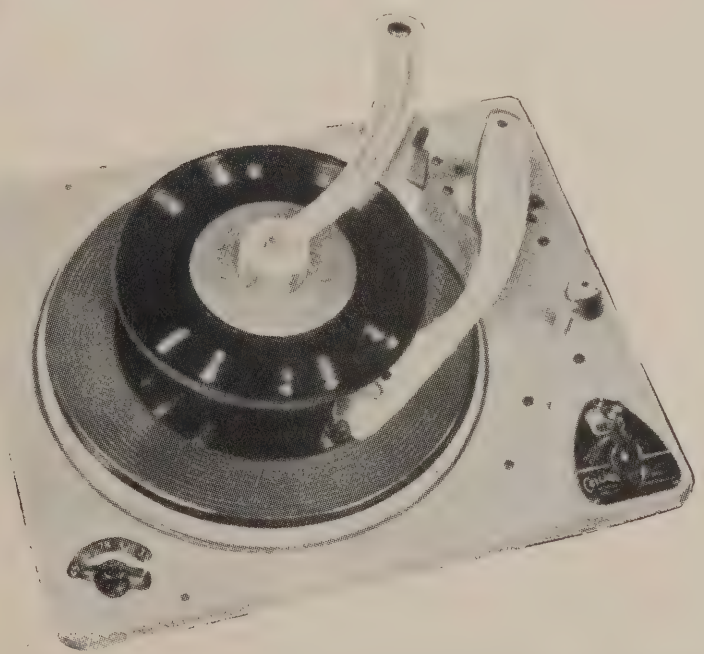

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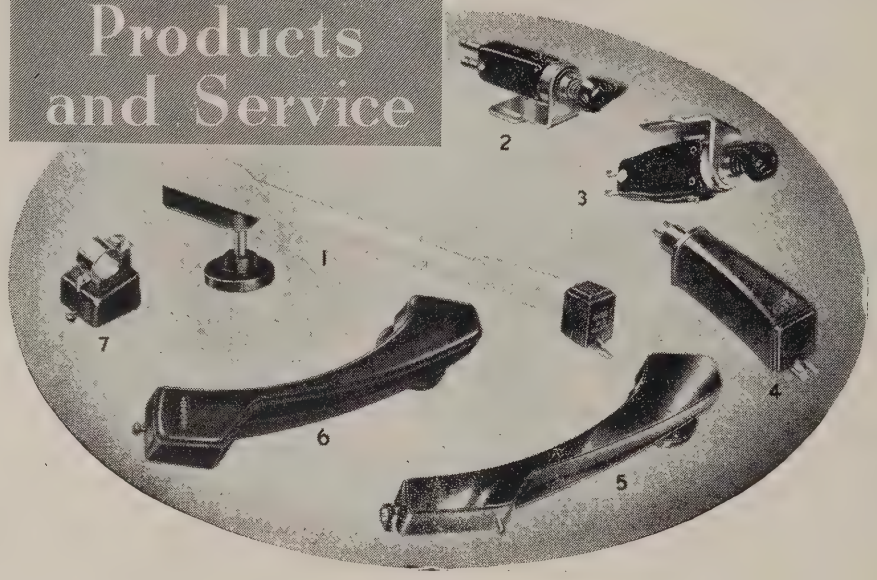


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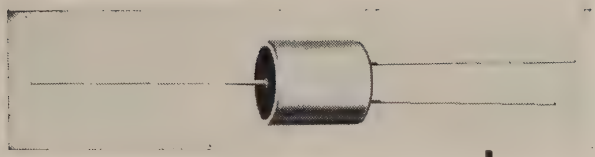

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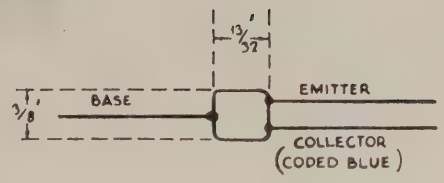


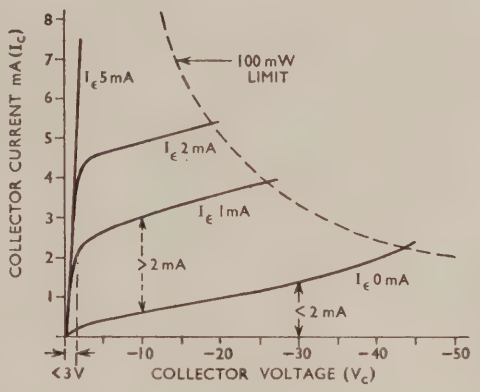


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### RATING

| | | |
|---|---|---|
| $V_c$ (collector voltage) for short-circuit stability at $V_e$=0* | −30 max. | V |
| $V_c$ (DC) | −50 max. | V |
| $I_c$ (collector current) DC | 15 max. | mA |
| $T_{op}$ (operating temperature) | 35 max. | °C |
| $p_c$ (collector dissipation) | 100 max. | mW |

Subject to $p_c$ max. not being exceeded.

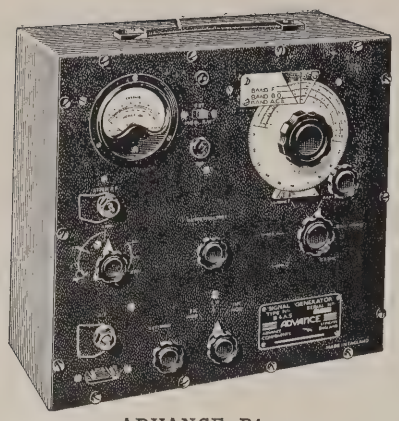
*$V_e$ = emitter voltage.

### CHARACTERISTICS

| | | |
|---|---|---|
| $I_c$ at $V_c$ = −30, $I_e$ (emitter current) = 0 | 2 max. | mA |
| | 1 average | mA |
| V (at $I_c$ = 2 mA) | 3 max. | V |
| | 1.5 average | V |
| $I_{gain}$ at $V_c$ = −10, $I_e$ range 0–1mA | 2 min. | |
| | 2.5 average | |

**GENERAL** The GET 1 is hermetically sealed in a metal can, which is insulated from the electrodes. The can may be earthed when necessary.

**BRITISH GENERAL ELECTRIC COMPANY LIMITED** Wellington, Auckland, Christchurch, Dunedin



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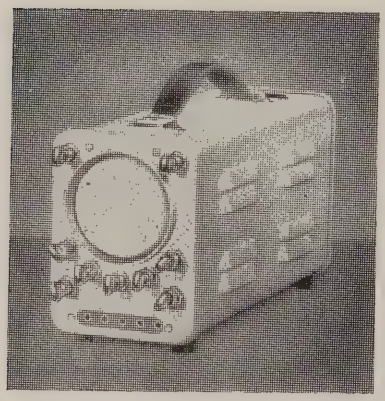

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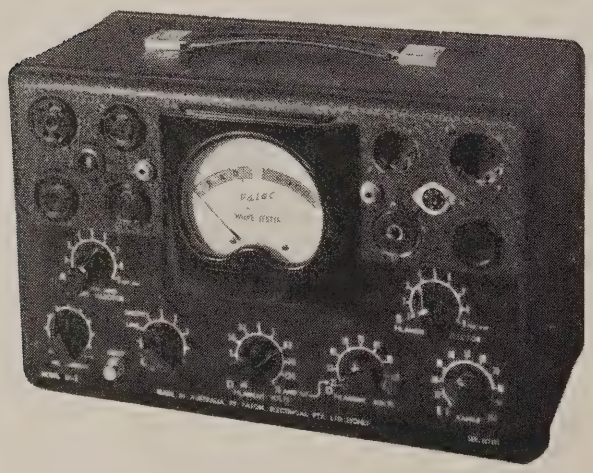

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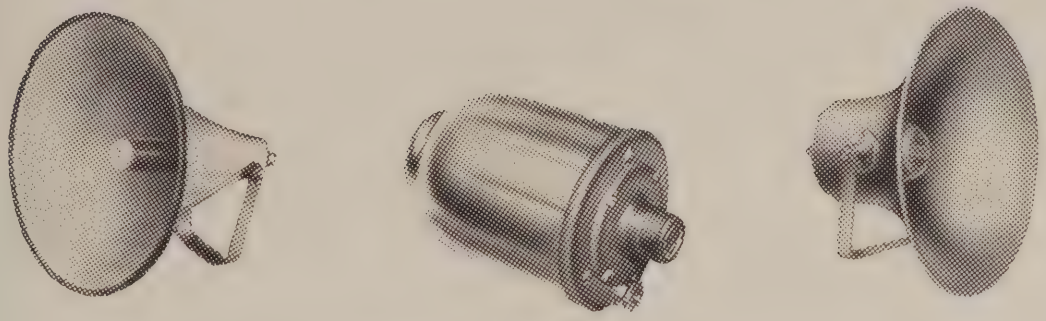

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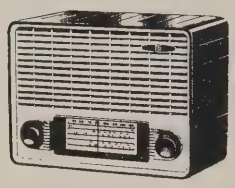

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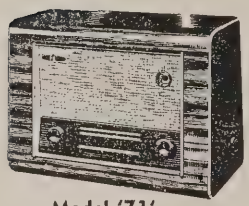

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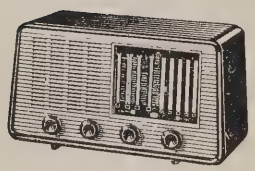

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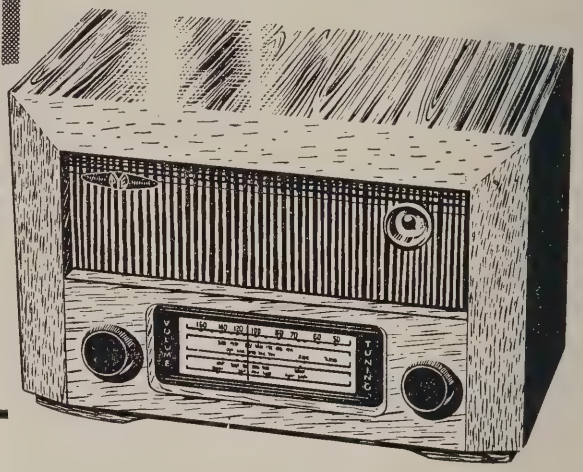

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# Car-Sets and the Radio Dealer

There is one branch of radio business which is by no means negligible in volume or potential earning capacity, but which seems to have drifted right out of the hands of the radio dealer. Needless to say, we refer to the sale, installation, and maintenance of car radio receivers. There would be little point in tracing the history of this development, but there is little doubt that the members of the radio trade are at least partly to blame. How many dealers today are willing to do anything about car radios? Many of them will not touch car-set servicing, nor are they at all keen to sell car-sets because they do not want to cope with the problems of their installation. To some extent, this is due to their having no drive-in facilities for the cars, but we suspect that the real reasons are to be found in the so-called difficulties attaching to jobs connected with car radios. For example, many dealers (or their servicemen) refuse point-blank to take a set out of a car for servicing. They may condescend to work on it if it is delivered on to their bench, and provided they do not have to put it back again. This attitude is merely a dislike for part of the job! Not that the installer and taker-out of car-sets does not deserve a good deal of sympathy sometimes. He does. Then, again, many servicemen and dealers seem to have a rooted conviction that car-sets are an invention of the Devil, which do nothing but pick up ignition interference and vibrator hash! As such, they argue, car-sets should be avoided like the plague by anyone who hopes to make his business pay.

We have mentioned these attitudes because they co-exist quite often with a complaint that car-radio business has been taken out of the hands of the dealers. The logical question at this stage is, "By whom?" Presumably, by the set manufacturers, in diabolical collusion with the motor industry. Those dealers who voice this complaint, and who profess to believe that they are well shot of the business anyway, really cannot have it both ways. It would be far too strong to say that the radio dealers have lost the car-radio market through apathy, because other even more powerful factors have been involved. Such a statement would have more than a grain of truth, however.

The point at issue today is clear, however. It is whether the radio dealer (a) should, and (b) can, retrieve the situation. Our own opinion is that the radio dealer should get back into car-radio business, and that, if he wishes, he can. Far be it for us to dictate to anyone what sort of business he should go in for. By saying he should, is meant that by not doing so he is passing by an opportunity of doing additional business, and therefore of increasing his own earnings. We mean, also, that, by training and experience, the radio dealer should be able to make a good job of such specialized business. Unfortunately, many dealers have never tackled it, and have no desire to, for reasons already stated. In other words, their training and experience have not fitted them for the job, but they can learn. There is nothing mysterious about making car-sets perform satisfactorily. True, they do have special problems of their own, but even these are not as difficult as they once were, for modern methods have made the lot of the radio man a much happier one than it used to be. The problems are rational ones that can be solved in a logical manner, and there is no reason why any competent radio man who so desires should not become proficient in this specialized branch of his art.

One of the difficulties confronting anyone who contemplates making a start with car work is that there appears to be very little published information on the subject. That is where "Radio and Electrical Review" might be able to help, and we hope to commence in an early issue a series of articles discussing the technical problems involved.

Apart from "know-how," there are other difficulties which are connected more with the financial side of things. Some dealers believe that unless they have first sold a car-set, thus obtaining the retailers' profit, it is not worth their while to provide maintenance for it. There is certainly something to be said for this view, although the point is obviously a debatable one, but we think the attitude betrayed by it is wrong. If one is selling a complex piece of equipment which is bound to need maintenance sooner or later, there is surely some sort of obligation to ensure that the necessary servicing facilities are available to the purchaser. There is no *a priori* reason why servicing should be done in a profitless manner, so that any dealer who wants to cash in on the sale of car-sets should be quite ready to provide service on them. Not the least important aspect of the matter is the goodwill that the dealer can build up with the buyer of a car-set. If the installation is carried out in a workmanlike and expeditious manner, the customer is more than likely to come to the same dealer for his domestic radio requirements, when they arise. No one, we repeat, is obliged to sell car-radios; it does seem, however, that there are some golden opportunities going to waste. Some astute dealers have even managed to make capital out of the fact that the motor dealers are often unable, through lack of specialized knowledge, to install the sets they sell, and contract to do all their installation and maintenance for them. These firms are managing without the retail mark-up on the sets!

Nevertheless, it is a pity that the radio dealers have lost a good deal of the car-set business, because, logically, it should be theirs provided they are prepared to back sales with service, and real service at that.

If those who would like to be in this line complain that they find difficulty in obtaining supplies of sets to sell, we can only reply that things will not necessarily be thus for ever, and suggest that a worthwhile preliminary to going into car-radio business would be to set up the machinery for carrying out maintenance on some of the thousands of sets that are now in service. Many of these are now reaching the age where they will start to need maintenance, and they will provide a wealth of experience for anyone who is interested.

# A HIGH-FIDELITY SYNCHRODYNE TUNER

## INTRODUCTION

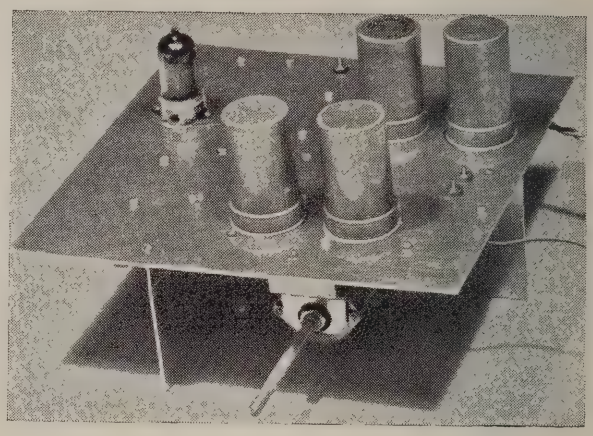
Those who were readers of "Radio and Electronics" in 1947 may remember an article in the September issue of that year, describing a new type of radio receiver called the Synchrodyne. This receiver worked on an entirely new principle, invented by Dr. D. G. Tucker, who at that time belonged to the research staff of the British Post Office. The theoretical advantages of the new system were such that when Dr. Tucker published his original article in "Electronic Engineering," it created a considerable stir in technical circles. This was hardly surprising in view of the claims made for it, for it breaks the ancient deadlock whereby selectivity and bandwidth are mutually exclusive. In other words, it is possible to have a receiver, working on the synchrodyne principle which has a flat frequency response out to 10,000 c/sec. or more, and yet is as effective in rejecting nearby signals as a conventional superheterodyne, whose audio response would be falling off severely at as low as 3,000 c/sec. In short, the synchrodyne should be the complete answer to the high-fidelity enthusiast's prayer.

At this stage, one might well ask why, if this is all true, the synchrodyne has not been universally adopted by high-fidelity fans. It is unfortunate, but true, that the new system has certain features which prevent it from being mass-produced. It can be made to work, and to do everything that might be expected of it, but it is still not exactly suitable to place in the hands of any and every unskilled user of a radio set. However, it is ideal as a subject for the many experimenters and constructors who are keen on high-fidelity reproduction. For that reason, we have revived the idea, and have produced a prototype in our own laboratory. This looks very promising indeed, and we see no reason why its results should not be duplicated by anyone with some experience of radio construction, provided he can follow instructions and recognize the symptoms that will be encountered while it is being set up.

When it is complete and working, what quality from the local broadcast stations! What clean, crisp reproduction, with the "highs" all there, just as they are heard from your own recordings. Better, in many cases, as when the National Orchestra is on the air direct from your local station, or when the remarkable quality of the N.Z.B.S.'s pick-ups is matched by some of the undoubtedly superb modern L/P recordings. Believe us, it will have been worth the trouble.

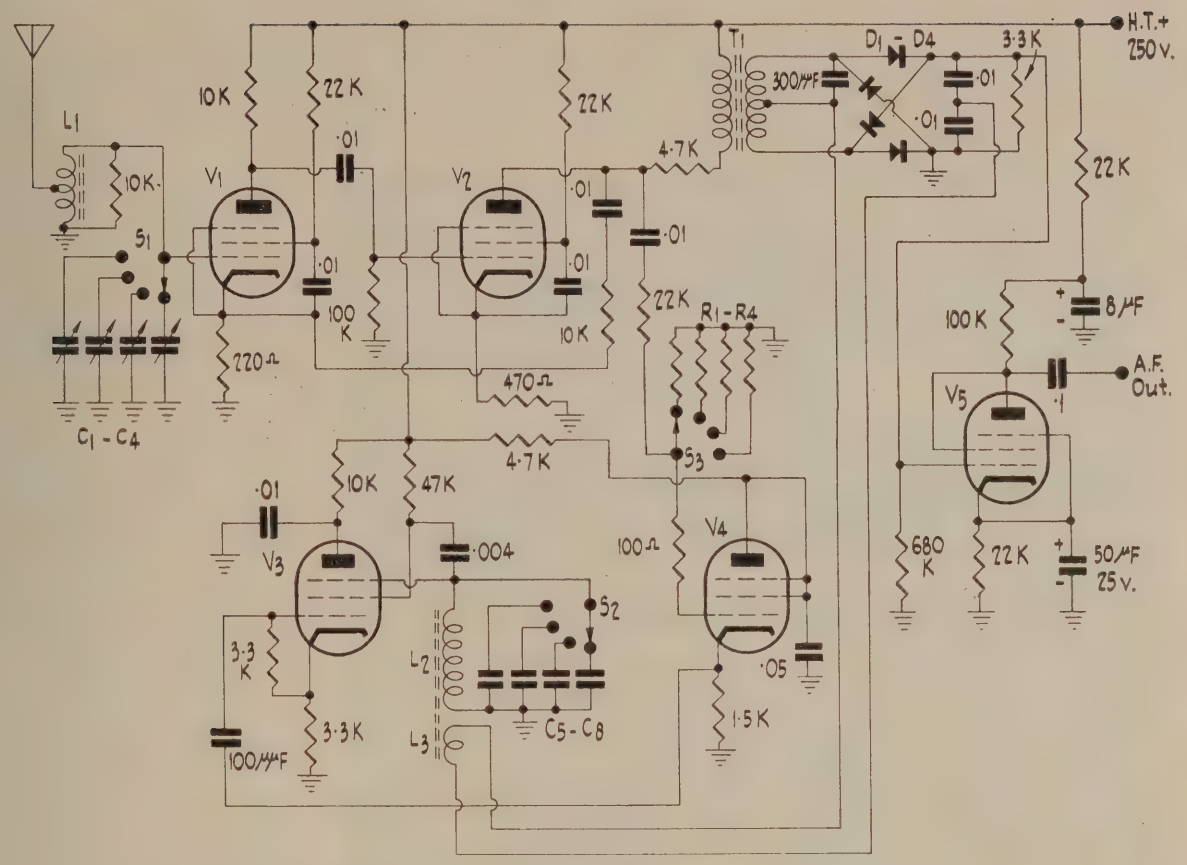
## THE PRINCIPLE

Fundamentally, the synchrodyne receiver consists of only three components: a source of signals—viz., the aerial, with or without an R.F. amplifier, an oscillator, and a special detector circuit known as a balanced modulator. The aerial and R.F. amplifier, if used, are relatively ordinary, but it comes as a bit of a shock at first to find that the oscillator operates at the same frequency as the carrier to be received. We can at this point visualize a number of pained expressions on readers' faces, indicative of the horrible heterodyne squeal conjured up by the thought of an oscillator on the same frequency as the signal, but luckily the actuality is a good deal less fearsome than



the thought. In practice, the oscillator works on **exactly** the same frequency as the station's carrier, so that there is no heterodyne at all. The oscillator is synchronized, or locked, to the carrier frequency, and it is this action which gives its name to the principle and to the receiver itself. For the moment, we can ignore the practical problem of how the oscillator is induced to synchronize itself with the received carrier, and have a look at the action which takes place when the mixture of modulated signal and local oscillator is fed to a balanced modulator circuit. Perhaps the easiest way of visualizing the action is to look on the arrangement as a frequency changer, or mixer, exactly similar in principle to the mixer of a superhet. In the latter, we know that the valve, acting as a detector on the mixture of signal and oscillator, produces new frequency components that were not present in either. These are sum and difference frequencies, of value $(f_o + f_s)$ and $(f_o - f_s)$. In ordinary receivers, both these new frequencies would be present in the output of the mixer if this were untuned, but, by dint of putting in a tuned output circuit, we select the frequency $(f_o - f_s)$, and call this the Intermediate Frequency, or I.F., of the receiver.

If the oscillator is on the same frequency as the signal, the two beat frequencies are still $(f_o + f_s)$ and $(f_o - f_s)$; the first of these is equal to $2f_s$, and the second to zero. On the face of things, this does not look very helpful, but when we remember that our signal does not consist simply of a carrier, but is modulated, things become a little clearer. In order to make the explanation reasonably simple, let us suppose that the carrier is modulated with a single frequency—say, 1,000 c/sec. This being so, the signal consists of three frequency components—the carrier, of frequency $f_o$, and the sidebands, which are single frequencies of $(f_o + 1{,}000)$ c/sec., and $(f_o - 1{,}000)$ c/sec. We now insert the additional signal from the oscillator, whose frequency is also $f_o$. Because of the detector action, the oscillator produces sum and difference frequencies with all three components of the




$C_1$ to $C_4$, aerial tuning condensers, to suit stations required.

$C_5$ to $C_8$, osc. tuning condensers, ditto. All these can be made up from paralleled fixed condensers, with trimmers in parallel for fine adjustment.

$R_1$ to $R_4$, resistors picked in order to obtain proper oscillator locking. See Page 26.

$L_1$, any stock aerial coil.

$L_2$ and $L_3$. 17 and 6 turns respectively on D17 Ferroxcube pot core.

$T_1$, primary. 70 turns, Sec., 14 turns a side, on D25/17.5/11.5/111b Ferroxcube core.

$D_{1-4}$ general purpose crystal diodes. $V_1$, $V_2$, $V_3$, $V_4$, EF50. $V_5$, EF40.

signal. Thus, in the output of the detector we have the following list of frequency components:—

$$(f_o + 1{,}000) - f_o = 1{,}000 \text{ c/sec.} \quad (1)$$

$$(f_o + 1{,}000) + f_o = (2f_o + 1{,}000) \text{ c/sec.} \quad (2)$$

$$f_o + (f_o - 1{,}000) = (2f_o - 1{,}000) \text{ c/sec.} \quad (3)$$

$$f_o - (f_o - 1{,}000) = 1{,}000 \text{ c/sec.} \quad (4)$$

$$f_o + f_o = 2f_o \quad (5)$$

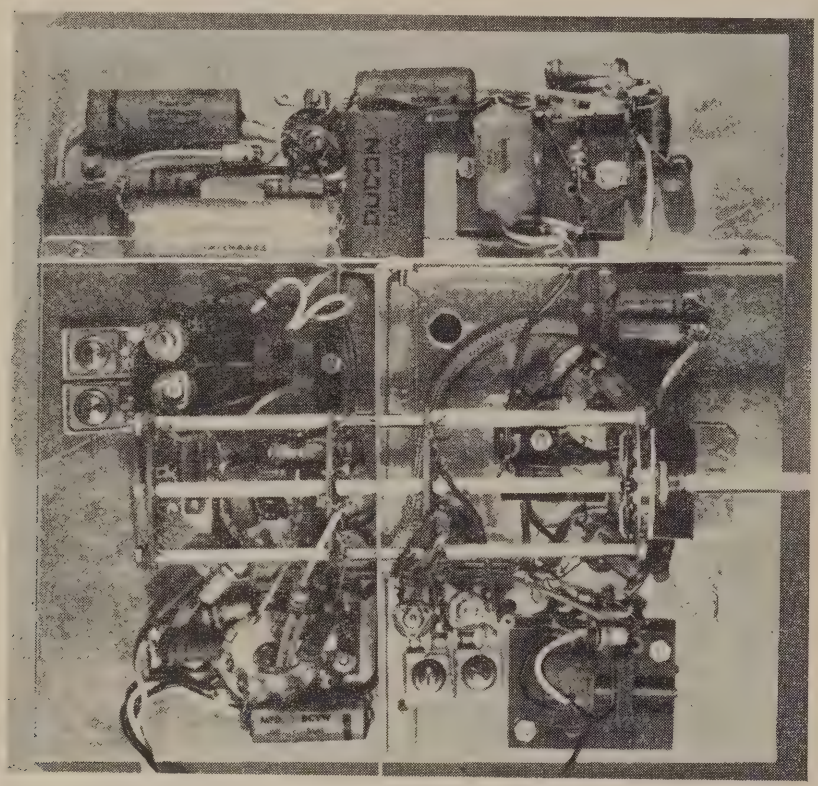
$$f_o - f_o = 0 \quad (6)$$

Of these, (1) and (4) are the modulation frequency, and are therefore the detector output; (2), (3), and (5) together make up a modulated signal at the second harmonic of the signal frequency, and are certainly not required. The detector circuit is so organized that these frequencies do not show up at the output terminal. The last, (6), is a D.C. component, which we need not worry about, since it is very small in magnitude, and will have no effect on the audio output. As a result of all this, when we feed the output of the detector to an audio amplifier, all that comes out is the modulation frequency.

## HIGH-FIDELITY RESULTS

It is not difficult now to see why it is possible to obtain high-fidelity detection of a broadcast signal, provided that the signal that is fed to the detector circuit has not had to pass through a selective amplifier, which would cut out the high-frequency sidebands and cause the high-frequency modulation components to be lost. The main reason why the synchrodyne possesses this desirable property is that it is highly selective, even if there are no tuned circuits at all ahead of the detector. The receiver relies for its selectivity, or discrimination against unwanted signals, on the action of the detector circuit itself, and **not** on the use of tuned circuits ahead of the detector. For example, take the case of two broadcast stations, 20 kc/sec. apart, and each modulated with audio sig-

nals extending to 10,000 c/sec. in frequency response. Each signal will consist of its carrier, and the sidebands, which will extend to 10 kc/sec. on either side of the carrier frequency. Thus, if they are spaced by 20 kc/sec., their sidebands will just fail to overlap. Suppose now that the synchrodyne oscillator is tuned



so as to receive one of the signals—the lower one, for the sake of argument. The lower sideband of the station on the higher carrier frequency will extend to just the same frequency as the upper sideband of the station on the lower frequency. When the heterodyne action of the detector takes place, let us suppose that the unwanted station is being modulated with a 9,000 c/sec. note. The radio frequency of the corresponding lower sideband will be 9 kc/sec. lower than the carrier frequency of the "interfering" station, and at the same time will be 11 kc/sec. higher than the carrier of the wanted station, Now, the detector circuit will produce a beat note of 11 kc/sec. with this unwanted sideband belonging to the wrong station, and a good audio amplifier will pass such a signal. But, if we have a low-pass filter, interposed between the detector and the audio amplifier, so that the detector passes on audio frequencies up to 10 kc/sec., but no higher, the interfering 11 kc/sec. note will not be heard at all, even if we have no selectivity whatever in the R.F. portion of the set, before the detector. There is another effect which adds to the selectivity of the synchrodyne, and which is due to the presence of the strong local oscillator signal in the detector circuit. This is known as the "capture" effect, and what it amounts to is that when a strong signal is applied to a detector, it greatly reduces the efficiency of detection towards other signals on slightly different frequencies. It is too difficult to describe in simple terms jn an article like this, and so we will not attempt to do so. But, in passing, we should perhaps mention that Dr. Tucker has shown that under certain circumstances the synchrodyne will even discriminate strongly against interfering signals whose carriers are so close to the wanted one as to produce a strong heterodyne in a conventional receiver.

It has been found, for instance, that, for ordinary purposes, by which we mean the use of the synchrodyne principle for broadcast reception, it is not even necessary to use a low-pass filter ffallowing the detector.

## ADVANTAGES OVER OTHER HIGH-FIDELITY TUNERS

Another question which will no doubt occur to readers is to ask what advantages if any the synchrodyne has compared with other schemes that have been recommended fir high-fidelity reception of local broadcast stations.

The most obvious one is that, with the synchrodyne, we can easily bring in our radio stations with an audio response that is quite flat out to their highest modulation frequency, and this is a thing that no other tuner has yet been able to accomplish. At this point, we must make an admission. The best wideband tuner we have been able to produce in the laboratory, other than the synchrodyne, was measured for frequency response towards a modulated carrier, and was found to be 3 db. down at 8,000 c/sec. The useful response, of course, would extend somewhat higher than this, but high-fidelity fans will certainly not consider this to be really extended high-frequency response. It is only fair to such a tuner, however, to say that the same high-fidelity fans have considered, on the basis of listening tests, that this tuner gave the best radio reception they had ever heard. Also, a conventional radio receiver, as bought in a shop, would show a 3 db. response drop at about 3,000 c/sec., which illustrates, first, what restricted response the public has become used to, and, secondly, that the "ordinary" wide-band tuner does effect a considerable improvement.

The synchrodyne, however, can be made to have an absolutely flat response out to the limit imposed by the modulation frequency range that is used by the broadcast stations.

Another advantage, which comes from the fact that the synchrodyne is inherently selective, is that it can be used in cases where two local stations are too close together to be easily separated by a conventional wide-band tuner. For example, a simple T.R.F. tuner, such as a good many enthusiasts used, is very inselective, and may not even separate 2YA and 2YC satis-

factorily, even though they are on 570 and 660 kc/sec. respectively. If the tuner is made selective enough to split these stations properly, it will not have a very wide-band response, and the object of the tuner is defeated. The synchrodyne, on the other hand, will separate stations much closer than this and still give the full bandwidth on each.

So much for the principles and advantages of the new kind of receiver. Let us go on and examine the practical problems of making one work.

## PROBLEMS TO BE OVERCOME

Although we have used this heading, it does not mean that the problems are insuperable, or even very difficult, particularly when one knows the answers in advance. Nevertheless, the actual building of a synchrodyne brings to light one or two difficulties that might not have been predicted in advance, and these add a good deal to the interest of such a project.

First of all, how do we go about synchronizing the oscillator with the received carrier? Do we have to be very fussy about the received signal strength, and do differences between stations make it difficult to lock the oscillator on all of them? Can we manage without a pre-set locking control which has to be adjusted every time we tune in a signal? If an R.F. amplifier is needed, how do we give it enough gain without at the same time introducing selectivity and side-band cutting? What happens while the oscillator tuning is being adjusted? Does the arrangement lend itself to tuning by push-button or selector switch? These are some of the practical questions that need to be answered.

The answers to these and other questions will appear as we go through the circuit and describe its functions in detail, but first of all it would be best to say something about the circuit in more general terms.

## THE PRACTICAL OUTCOME

It is quite possible to build a synchrodyne receiver without any amplification at signal frequency, but not very desirable. This is because synchronization of an oscillator requires a certain minimum signal voltage in order to be possible. Luckily, the voltage actually required is quite small, being only of the order of millivolts, so that when a good aerial is available, it is practicable to do without any R.F. amplification. But if some amplification is used, it is possible to have synchrodyne working from even a short indoor aerial. Alternatively, one can receive successfully quite weak signals, which could not otherwise lock the oscillator.

Unfortunately, it is not possible to make use of a conventional R.F. amplifier, for the following reason. First, we do not want to use appreciable selectivity ahead of the detector, because doing so would defeat the object of the receiver. This being the case, we are limited to only one tuned circuit, and that quite heavily damped with a 10k. resistor. Consequently, any very strong local signal that is not very far removed in frequency from that to which the input circuit is tuned, will produce an appreciable signal voltage at the grid of the first valve. If the R.F. amplifier is quite linear, and therefore distortionless, the presence of two signals will not matter, for the inherent selectivity of the synchrodyne detector will sort them out quite well. But if the R.F. amplifier produces distortion, intermodulation products will be produced, and these will take the form of unwanted R.F. signals. By an unfortunate combination of circumstances, it would be possible for these to produce heterodynes with the desired carrier. Also, there would be distortion of the modulation because of intermodulation between the side-bands of the signal itself, and this would give a distorted output signal. Ordinary remote-cut-off R.F. pentodes automatically distort slightly any R.F. signal they are handling, because of their curved characteristic. In a tuner like this, which is capable of handling the highest modulation frequencies, distortion is even more undesirable than usual, because of the well-known effect whereby it becomes more noticeable the wider the frequency range that is passed by the system.

It is in order to reduce distortion that a two-stage resistance-coupled amplifier is used, with negative feedback from the plate of the second stage back to the cathode of the first. From the distortion point of view, this is very much better than using a single stage of higher gain. The tuned aerial circuit is used not for the small amount of signal amplification it could afford, but to give a little attention to strong signals other than that being received, and so further reduce distortion.

The second R.F. stage feeds the detector circuit through an untuned transformer, $T_1$. In series with its primary is a small resistor whose function is to flatten out the natural resonance between the transformer windings and their self-capacity. The transformer is used in order to step down the circuit impedance to a value which is suitable for the low-impedance detector circuit, comprising the four diodes.

The oscillator is $V_3$. This is connected as a transitron, which is an arrangement having special advantages for a synchronized oscillator. Feedback is "electronic," being determined by the connection of the valve electrodes instead of by a feedback winding, so that a transitron oscillator needs only the tuned winding. A second small winding is coupled with the tuned winding to step down the signal voltage, and to provide a low-impedance source for the oscillator signal to the detector circuit. The step-down ratio is such that approximately 2 volts peak is obtained across the terminals of $L_3$, A second advantage of the transitron is that the control grid takes no part in the oscillator action, and so is free for use as an injection electrode, for receiving the synchronizing signal voltage without upsetting the oscillator's operating conditions in any way. It will be noticed that the control grid is **not** biased by the cathode resistor, but that the suppressor is. This suppressor bias is essential, for without it, the oscillator will not function.

Signal voltage is fed into the oscillator control-grid circuit from a cathode follower, the purpose of which is to act only as an isolating stage between the R.F. amplifier and the oscillator, thus reducing the effect of the synchronizing amplitude control on the oscillator frequency. The chief advantage of the transitron, however, lies in the fact that although it is a stable oscillator, it is very easy to synchronize. In general the two things are contradictory, while a conventional oscillator designed to be reasonably stable is quite hard to synchronize.

In setting up the synchrodyne, it is best to use as small a synchronizing signal as possible. Ideally, the signal used to synchronize the oscillator should not

be a modulated one at all, but the modulated signal has been found to cause no difficulty, provided it is not too large in amplitude. If it is, very much distorted sidebands are produced at the oscillator output in such strength as to be unacceptable, as the distortion becomes readily audible in the output. Consequently, the smaller the synchronizing signal, the better. The amplitude, moreover, must be adjustable for each station that is to be received. In the present set-up, which uses pre-set tuning one switch bank is used up in altering the synchronizing input. The 22k. resistor, with the appropriate resistor selected by $S_3$, form a simple voltage divider. It is not possible to specify the values of $R_1$–$R_4$ that must be used in a given location, with a given aerial, since the values depend entirely on the signal level at the plate of $V_2$ in each separate instance.

The detector circuit, using four crystal diodes, is a type of balanced modulator. The secondary of $T_1$ is centre-tapped, so that the signal is applied to the diode circuit in push-pull. The oscillator voltage, on the other hand, is fed in phase to each side of the symmetrical diode circuit. The detailed action of the arrangement is outside the scope of this article to describe, but it might be mentioned that one purpose of the balanced modulator circuit is to prevent audio output occurring through simple detection of the R.F. output of the transformer. In theory at least, there should be no audio output if the oscillator is disconnected or stopped, but in practice this will not be found to happen. The reason is that in theory the circuit is perfectly balanced, but in practice it is not. When the oscillator is present, its signal acts as a switch, opening two of the diodes, and closing the other two on each half-cycle of the carrier voltage. On the opposite half-cycle, the two diodes that were conducting become cut off, and vice versa. Provided that the oscillator signal is much larger than that of the station being received, the distortion produced by a balanced modulator is very small.

The output is fed directly to the grid of an audio amplifier, since the peak output voltage is only about 100 millivolts, which is insufficient for driving many amplifiers to full output.

## CONSTRUCTION

The form of construction used for the prototype is quite clearly illustrated in the photographs. The tuner has been built on a flat plate which can serve as a sub-chassis, and be dropped into a hole in a main chassis which could, for example, house the main amplifier. Two baffle-shields and a small bracket to hold the front end of the selector switch complete the mechanical portion of the job. In the under-chassis photograph, the front compartment is in the bottom of the photograph, and contains the R.F. amplifier valves. Only one section of the switch is in this compartment, for switching the aerial tuning circuit. The valve sockets are placed as close together as possible, and the wiring is done in as short and direct a manner as possible. Insulated tie-points are provided for the H.T. line and for the two 0.01 $\mu$f. condensers which attach to the plate of the second stage. The other components can be soldered directly to the valve pins. The transformer $T_1$ is mounted on the opposite side of the baffle shield from the amplifier tubes, and a twisted pair of leads is taken through into the oscillator compartment, which is the upper one in the photograph. The oscillator and cathode-follower valves are in this compartment, with the oscillator tube on the right in the photo. Two wafers are used in this compartment so that the switch sections concerned with oscillator tuning and locking injection can be physically separated by a few inches. The back section is for the oscillator tuning, and the adjustable condensers can be seen beside it.

## ADJUSTMENT

After the wiring is complete, there comes the most interesting part of the whole job, namely adjusting the circuit. At the outset, it should be realized that there are four separate lots of adjustment to make, one for each station. Further, it is quite useless to commence the final adjustment until the tuner is set up in the spot in which it is to be used, and with the aerial which is to be used as well. There is no need for the latter to be a particularly good one, because there is enough sensitivity present to cope with a reasonably sized indoor aerial, The main point to realize is that the adjustment is critically dependent on the signal strength, so that final adjustment MUST be made with the aerial it is intended to use permanently. The steps to be taken are listed below:

(1) Pull out the oscillator tube, and connect the audio output either to a pair of 'phones or to the input of an amplifier.

(2) Install the aerial tuning condenser combination that will suit the lowest-frequency station to be received, and tune for maximum received signal. This will not be very strong unless one is very close to the transmitter, because of the effect already mentioned, whereby the balanced modulator does not give much output unless the oscillator is functioning.

(3) Plug in the oscillator, after installing the appropriate tuning capacities, and tune until a loud heterodyne is heard, indicating that the oscillator is beating with the desired signal. Ignore any weak heterodynes that may be faintly heard, and set the oscillator tuning as close to zero beat as possible. In order to do this properly, there must be no locking voltage fed to $V_4$, so that a temporary short should be placed from the moving arm of $S_3$ to ground. The value of the resistor $R_1$ can then be found by trial. Start with a 4.7k. resistor for $R_1$. Short it out with a screw driver while the oscillator tuning is adjusted to near zero beat, then remove the short. If the locking voltage is correct, or too great, the result will be that the oscillator locks in with the carrier frequency, and the heterodyne completely disappears. If the locking voltage is too small, the heterodyne will persist, and only a very accurate adjustment, with the oscillator's free-running frequency very close to that of the station, will allow synchronization to take place. If that is the case, increase the locking voltage by making a 50% increase in $R_1$, and trying again. When the locking voltage is great enough, it will be found that the oscillator falls into lock very easily, even when the free-running frequency is several hundred cycles away from the carrier frequency.

(To be concluded).

*Circuits for the Experimenter*

# A Novel Time-base Circuit for Oscilloscopes

Over the years, there have been innumerable circuits devised and recommended for use as oscilloscope time-bases. All of them have their own peculiar advantages—and disadvantages—which make them suitable for application in different circumstances. Some, for example, are very inexpensive. Others are easy to make linear at high frequencies, but not at low. Some provide only a small output voltage, making an amplifier essential, while others have such a large output as to render an amplifier

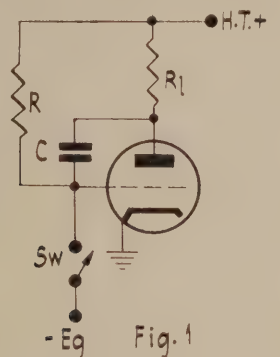


Fig. 1

unnecessary. Some give as a by-product a square-wave which can be used for blanking the flyback of the trace, while others do not. This list could be elaborated at some length, but with little purpose, except perhaps to show that none of them are ideal. Needless to say, it is possible to design a time-base circuit which possesses almost all the desirable features, and none of the undesirable ones, but this can only be done if the number of valves used is to be disregarded. Such a circuit would hardly be suitable for inclusion in an ultra-compact portable instrument, and by the same token, few if any of the simple circuits that would be suitable for the latter would find a place in a precision synchroscope. The circuit which forms the basis of this article is rather a special one. It uses two and a half double triodes, and so can hardly be said to come within the economy class, but against that, it can set some unusual advantages, including one that might almost be described as unique.

## ORIGIN OF THE CIRCUIT

The complete circuit given as Fig. 2 herewith has its origins in British wartime radar equipment, where requirements arose for linear sweep voltages of very high precision—much higher than the commonly used time-base circuits of the day were capable of giving. The principle on which it is based was invented by Blumlein, who was perhaps the most outstanding circuit designer in Britain prior to and during the war, and who was largely responsible for the design of the world's first high-definition television broadcasting station.

This principle is illustrated in Fig. 1. The valve is a conventional resistance-coupled amplifier, which we have shown as a triode for convenience, although a pentode is often used in practice. $R_1$ is its plate load resistor. R is a resistor of high value, through which the condenser C can charge during part of the operating cycle. The switch can be closed or opened at any convenient time, and when closed, it connects the grid directly to a source of negative bias, which is great enough to cut off the plate current of the tube.

If the switch is closed, the valve is immediately cut off, and is effectively removed from the circuit. The condenser is thus able to charge rapidly through the relatively low resistance of the plate load resistor. When the condenser has become fully charged, nothing further happens until the switch is opened. When this is done, the valve immediately starts to conduct, and at the same time, the condenser begins to discharge, through the high-value grid leak R. If it were not for the presence of the condenser, the valve would immediately start to pass maximum current, with its grid drawing current too, but since the grid is directly connected to the lower end of C, its potential cannot rise at a faster rate than the discharge of the condenser. As soon as the valve starts conducting, it also amplifies, so that the first slight rise in the potential of the grid above the cut-off potential of the valve causes an amplified drop in plate potential to occur. At least it would do were it not for the fact that the condenser represents a feedback connection, in which the whole of the output voltage is fed back to the grid. Now when this takes place, the original change in grid voltage is opposed by the change in plate voltage, which tends to prevent the grid voltage from rising. The sum total result is that the grid potential rises at only a very slow rate indeed. In consequence, the plate voltage falls equally slowly. Obviously, the rate at which the condenser actually discharges, depends not only on the values of C and R, as is normal in the discharge of a condenser through a resistor, but also on the amplification of the valve.

Perhaps an easier way of visualizing the action is to remember the famous Miller effect, whereby the effective grid-plate capacity of a tube is equal to the actual grid-plate capacity multiplied by the amplification of the valve. Here, we can regard the condenser C as the **actual** grid-plate capacity (which it is, since C is very much larger than the inter-electrode capacity itself) and this in turn is multiplied by the amplification of the valve. The circuit—R, C, and amplifier—is thus equivalent to a simple R C circuit in which C has a value A times its actual value.

In order to see how this action increases the linearity of the discharge of the condenser, all we have to do is to remember the fundamental action of all saw-tooth generators, which without exception work by charging and discharging a condenser. The discharge curve, which is a graph showing the manner in which the voltage on the condenser varies with time, as the discharge takes place, is always exponential in shape. This curve has the property that at the start, it is almost linear. Thus, to generate an almost linear fall in potential, all we have to do

is to select only the very smallest fraction of the discharge curve. Indeed, the condenser is allowed to discharge only a very small amount before it is recharged, allowing the next discharge to take place, and completing the cycle of events. One way of selecting the very first part of the discharge curve is to charge the condenser to a very high potential, and recharge it after it has discharged through only

## THE MAIN ADVANTAGE

It should hardly be necessary at this stage to state what the main advantage of the circuit is, namely, exceedingly good linearity. So far, though, we have hardly arrived at a practical device! Unless the repetition rate is very low, we are unlikely to induce anyone to open and close a switch manually every time a single trace is required on the screen.

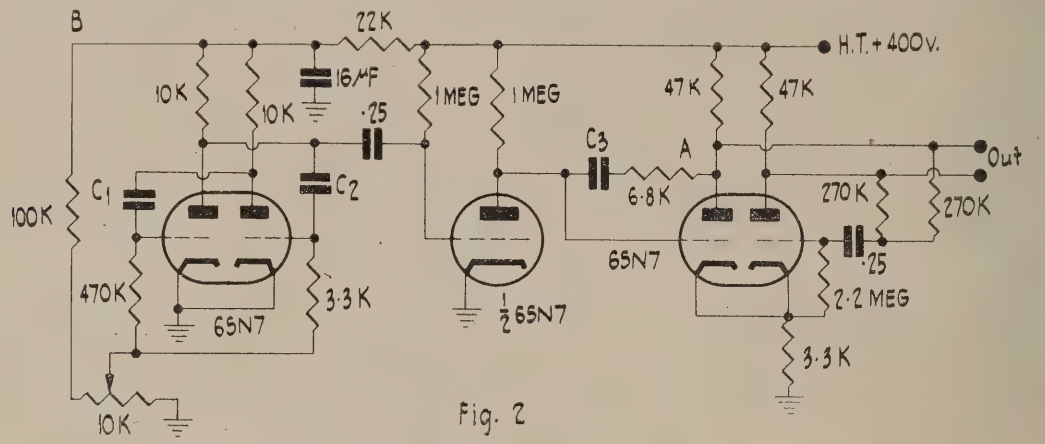



Fig. 2

a few volts. Another way, which amounts to the same thing as far as linearity is concerned, is to increase greatly the size of the condenser, leaving the voltage as before, and thus reducing the fraction of the discharge curve that is used, when the condenser is recharged after a given time. The Miller-Blumlein circuit has the advantage of producing a very linear sweep by the method just outlined, and at the same time, its amplification makes up for the loss of output voltage that occurs when the condenser is made larger. For example, suppose the condenser is 0.1 μf. actual capacity, and that the valve gain is 20 times. The effective size of the condenser is thus not 0.1 μf., but 2.0 μf.; the linearity of the discharge curve is thus identical with what would be obtained if an actual condenser of 2 μf. had been used in conjunction with the same discharge resistor R. Another way of looking at it is to say that the linearity is the same as would be obtained by charging the 0.1 μf. condenser to 20 times the actual charging voltage, and then discharging it by the same amount as that by which it actually does discharge. In other words, the portion of the discharge curve is now only a twentieth of the portion that would have been used without the aid of the valve.

As can be imagined, this kind of circuit can give almost unbelievably linear waveforms at the plate of the valve. For instance, with a pentode having a gain of 200 times (which is not out of the way at low frequencies) and an actual H.T. voltage of 400, a saw-tooth of about 200 volts peak-to-peak amplitude can be obtained. This is one half of the actual voltage to which the condenser is charged, and without the assistance of the valve circuit, the discharge curve would be anything but linear. With the valve, however, the 200 volt saw-tooth is obtained with a linearity equal to that which would be obtained by taking the first 200 volts of the discharge of a condenser charged to 80,000 volts!

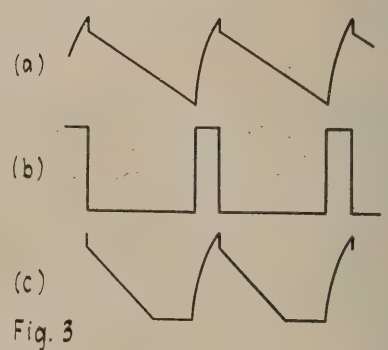



Fig. 3

Luckily it is an easy matter to operate the switch electronically at almost any desired rate, and the first three triodes in the circuit of Fig. 2 perform this function.

In radar and television circuits, where the Miller-Blumlein circuit is often to be found, pulses usually abound by whose means the switching action can be performed. In an oscilloscope, however, these pulses must be made, and in addition, they must be capable of being produced at any rate from a very few, to several thousand a second. Accordingly, the first 6SN7 is a highly asymmetric multivibrator. That is to say, one of its tubes is cut off for a much larger portion of the oscillation cycle than is the other, so that instead of a square-wave with a mark-space ratio of one-to-one, as is produced by a multivibrator with symmetrical values of components, this one gives a waveform which looks like (b) in Fig. 3. This waveform is applied to the grid of the next valve, which plays the role of the switch in Fig. 1. When the long negative peaks of the waveform occur, they take the grid of the switching valve below cut-off, so that the valve

ceases to conduct, and the switch is open. On the positive peaks, the valve conducts, as heavily as the 1 Meg. plate resistor will allow it to, and its plate immediately descends to within a few volts of earth potential. This is the closing of the switch, and while it is closed, the condenser re-charges quickly, forming a flyback of the saw-tooth. The waveform at (a) in Fig 3 is the output at the point A—the plate of the Miller valve, and this is applied to one X plate of the cathode ray tube.

The waveform at (a) is the saw-tooth voltage obtained if the time-constant of $C_3$, (the condenser C in Fig 1) together with the 1 Meg. resistor (R on Fig. 1) is not too large. If it is too large, the waveform at (c) is obtained. The positive peaks of the plate waveform occur only when the valve is cut off, and so are at the potential of the H.T. line. As the linear run-down takes place, a plate voltage is reached, lower than which it cannot go. This point corresponds with the onset of grid current, and simply means that the plate has reached "bottom," since the plate current can no longer keep on increasing. Thus, the linear run-down ends abruptly, and until the switch is closed again, the plate potential remains low and constant. The effect is as if a saw-tooth of somewhat larger amplitude than (a) had had its tip cut off.

At first sight, it might be thought that a waveform like (c) would be of no earthly use to anyone, but such is far from being the case. In point of fact, it enables a very special "trick" to be done with this time-base, viz. the securing of constant amplitude, regardless of frequency—a feature possessed by very few time-base circuits.

## CONSTANT AMPLITUDE TIME-BASE

In Fig. 2, we have made provision for continuous variation of the frequency of the multivibrator. This is the purpose of the 100k. potentiometer to which the grid leaks are returned. With the values shown, the frequency range is of the order of 3.1, while coarse variation may be had by altering $C_1$ and $C_2$ in steps. The switching has been omitted for the sake of clarity.

Let us suppose that we have the fine frequency control set so as to give the highest frequency. We then have to choose $C_3$ according to the type of time-base we want. If we use a value just small enough to give waveform (a), we will get a waveform like (c) at all other frequencies in the range. Because we have chosen $C_3$ in this way, the amplitude of the waveform will be the same at all frequencies. Likewise, even if we change ranges by switching the three condensers, the amplitude will still be constant. The only disadvantage of this procedure is that at the right-hand end of the trace, a bright spot will appear because the spot is stationary there, for some time before the flyback occurs. But if we take steps to black out every part of the trace except that corresponding with the linear dun-down, the appearance will be excellent.

## BALANCED DEFLECTION

Most often, balanced saw-tooth voltages are required, for feeding to both X-plates at once. For this reason, the second half of the right-hand valve in Fig. 2 is used as a self-balancing phase inverter. The balance is not particularly good, but is effective in preventing deflection de-focussing, as occurs with most tubes when unbalanced deflection is used.

## BLACK-OUT CIRCUIT

In Fig. 4 is shown a circuit which will enable a black-out waveform to be obtained, for blanking the unwanted part of the trace. It is connected as shown, and the output is taken from its plate to the grid of the C.R.T. The condenser $C_4$, together with the 100k. grid leak forms a differentiating circuit, which converts the output waveform into a suitable one for amplifying and using as a black-out voltage. $C_4$ needs to be changed for each range.

## CONCLUSION

There is a good deal more that could be said about this circuit, but space does not permit at present. We have plans for incorporating a time-base like this one in a new oscilloscope which we are designing, and any additional information will have to wait till then. In respect of performance, it may be said that the linearity of the time-base produced by it is by no means as good as can be obtained. It is pointless, however, to try and improve on it, because as it is, it is impossible to observe any improvement on a C.R.T. screen.

## TABLE OF VALUES

| | 40-160 | 350-1200 | 1.7-7 | 6-24 |
|---|---|---|---|---|
| | c/sec. | c/sec. | kc/sec. | kc/sec. |
| $C_1$ ..... | 0.004 $\mu$f. | 600 $\mu\mu$f. | 100 $\mu\mu$f. | 25 $\mu\mu$f. |
| $C_2$ ..... | 0.01 $\mu$f. | 0.001 $\mu$f. | 250 $\mu\mu$f. | 100 $\mu\mu$f. |
| $C_3$ ..... | 0.01 $\mu$f. | 0.001 $\mu$f. | 250 $\mu\mu$f. | 100 $\mu\mu$f. |
| $C_4$ ..... | 0.001 $\mu$f. | 100 $\mu\mu$f. | 25 $\mu\mu$f. | 10 $\mu\mu$f. |

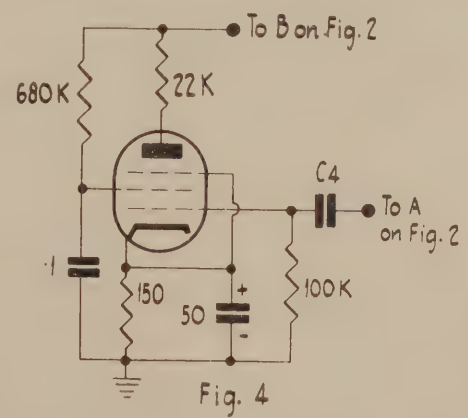


Fig. 4

A great advantage of this circuit is that just as linear sweeps may be produced at frequencies almost as low as we please, as at middle and high frequencies. Moreover, the condensers required for quite low frequencies are not, as in some circuits, inordinately large. As for high-frequency performance, about the useful top limit is that given in the table. This appears at first sight to be unduly low, but actually it is not. Among other things, this time-base has the peculiar property of sweeping much faster than would a conventional time-base, running at the same repetition rate.

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### INTRODUCTION

For anyone just starting off in the amateur radio hobby, the choice of a suitable receiver for a first attempt at something suitable for communications work is a difficult problem. The same problem often has the old-timer by the ear, just as much as the newcomer, so that the latter need not feel unduly helpless when setting out to choose from among the innumerable features it is possible to include! We hope this series of articles will throw some light on the general problem for him, and that it will present a practical solution which can be made use of as the new call-sign comes into use, and for some considerable time afterwards. The receiver about to be described will not have the superlative performance of the latest commercial sets, nor that of some of the even more outstanding "one-off" receivers built by the expert "ham" after years of experience. That goes without saying, for with receivers, more than most things, it is true to say that one can't have everything. There is the over-riding necessity for keeping a beginner's receiver reasonably simple, and this automatically rules out many of the frills of the more advanced job. We might even be guilty of mild heresy and say that a good, simple receiver will give the user more satisfaction and actual operating time than one with all sorts of gadgets on it, all of which take time to adjust, and which are even a disadvantage in the hands of all but the expert.

### WHAT FEATURES ARE ESSENTIAL?

First of all, let us make a list of those features which can be reckoned as indispensable in any amateur-band receiver.

**(1) Bandspread:**

Some means of spreading out the narrow amateur bands over a reasonably large portion of the dial is a "must." In other words, the set must be easy to tune and to handle generally, without critical adjustments. Of the features which give a receiver these qualities, bandspread is undoubtedly the most important.

**(2) Selectivity:**

In these days of crowded bands, especially 80, where the beginner will almost certainly start operating, reasonably high selectivity is essential. On the other hand, it is quite unnecessary in the first months of possessing a "ticket" to use any of the super-selectivity schemes so beloved of the older operators. A little operating patience in the early stages is far better than a lot of constructional difficulty.

**(3) Sensitivity:**

Since we are assuming that a start is to be made on 80 metres, extreme sensitivity is not essential. Adequate sensitivity will be obtained with a modern valve line-up without using a stage of R.F. amplification, especially if care is taken with the aerial input arrangements. There is no need to listen very hard to those who make a fetish of low-noise techniques, because on 80 metres the noise level of the set is limited rather by QRM and QRN than by the noise generated within the set by its valves and tuned circuits.

**(4) Beat Frequency Oscillator:**

Some sort of beat oscillator for receiving CW will be essential. If the set is to be a T.R.F., the detector (regenerative, of course) is its own B.F.O., while in a superhet., we can use a separate oscillator, or make the second detector regenerative, and again act as its own beat oscillator.

These four features are the only ones which we would put down as absolutely necessary. Provided adequate, but not excessive, sensitivity and selectivity are available, and as long as a simple bandspread scheme is used to make tuning easy, and some means is provided for giving an audible beat note from CW signals, the receiver will do most of the things that are likely to be asked of it. We do not pretend, of course, that this is all there is to the matter. Far from it; but, by concentrating on first things first, and being ruthless if need be about features of doubtful practical value, a great deal of difficulty can be avoided from the outset.

### SUPERHET OR T.R.F.?

Perhaps the most vexed question regarding one's first receiver is whether it should be a T.R.F. or a superheterodyne. While there is no doubt that the former can be made to have excellent performance in some respects, it has certain disadvantages. The chief one is that it is very inselective against strong local signals. Up to a point, the same thing can be said of the superhet., but the latter definitely has the advantage in this respect. Another major disadvantage of the T.R.F. is that, in order to have enough sensitivity, it must use a regenerative detector. Now, when a set relies almost wholly on regeneration for its sensitivity and selectivity, it is inher-

ently more tricky to operate and less stable in its characteristics with regard to variations of line voltage, unless it is powered from batteries. These days, no one wants to use a battery set when 230-volt A.C. mains are available, and the number of people who are without the benefit of A.C. are fortunately very few in New Zealand today. On the other hand, a superhet., even though it may have a regenerative second detector as an aid to selectivity, and to provide a beat oscillator with the minimum of trouble, does not rely on regeneration for most of its sensitivity and selectivity. As a result, the amount of use the regeneration control gets is much less; even when it is used, it has the tremendous advantage of working at the fixed frequency of the I.F. Consequently, many of the disadvantages of regeneration disappear. For example, if the reaction control is set so as to give a suitable amount of selectivity, without actually allowing the detector to oscillate, tuning round the band will have absolutely no effect on the amount of regeneration obtained. With a T.R.F., the reaction control must be re-set every time the tuning control is touched.

Another advantage of the superhet. is that adequate sensitivity can be obtained without recourse to a tuned R.F. stage. Making a stable R.F. stage with useful gain is not the easiest of jobs, and, with a superhet. circuit, it can be avoided. An I.F. amplifier stage gives more gain, and is easier to construct, so that, in spite of the apparently greater complication of the superhet., it is really an easier set to get going. On several counts, the superhet. is to be preferred. The biggest disadvantage of the superhet. is image interference. Usually the local oscillator is made higher in frequency than the signal, so that the I.F. beat, which the I.F. stage amplifies, has a frequency of $F_o - F_{sig} = 455$ kc/sec. Unfortunately, there are two frequencies that can beat with the oscillator to give output on 455 kc/sec. The other one is 455 kc/sec. **higher** in frequency than the local oscillator, and if it is present at the grid of the mixer circuit it, too, will produce a signal capable of passing through the I.F. amplifier. But the grid circuit of the mixer is tuned to the desired signal frequency, and not to that of the "image," as it is called. Theoretically, then, there ought not to be any signal at image frequency present in the mixer. This would be so if the selectivity of the mixer grid circuit were perfect, but it is not. Thus, although the mixer grid circuit will reject the image signal to some extent, there are bound to be occasions when there is a signal on the image frequency that is so strong as to ignore the selectivity of the input circuit and break through regardless. The result in the speaker is just the same as if the interfering signal were on the same frequency as the wanted one. A little thought will show that it must actually be higher than the wanted one by twice the I.F., or 910 kc/sec., if the I.F. is 455 kc/sec. This is why some sets start off with an I.F. that is a good deal higher than 455 kc/sec., because the higher the I.F., the farther from the wanted signal is the image, and thus the better chance the mixer grid circuit has of rejecting it and its interfering proclivities. Image signals are also the reason, or rather one of the reasons, why more complex superhets. employ R.F. stages. The more selectivity ahead of the frequency changer, the less image interference. A great improvement in the image interference of a set which does not include a tuned R.F. stage may be had by using a separate aerial-tuning circuit, much as is done with a transmitter, which has its own final tank circuit, but which more often than not also has a separate aerial tuning circuit. For this reason we have included such a circuit in this receiver.

## PLUG-IN COILS VERSUS SWITCHING

The general form of the receiver having been decided, it remains to settle some of the details which are nevertheless very important. Perhaps the chief of these is whether band changing should be done by means of plug-in coils or by switching. Switching is certainly much more convenient than the other, but it is our opinion that more performance has been sacrificed on the altar of convenience than on any other. The arguments for and against both types of band changing are many and varied, and we do not propose to propound them in detail here. Suffice it to say that we have decided on plug-in coils for these can certainly be made to perform excellently, especially when there is no R.F. stage to complicate the lay-out. In fact, one of the advantages of plug-in coils is that they lead to an excellent lay-out of parts in the R.F. circuit of the receiver.

## OTHER DETAILS

### (1) Gain Control

Since we have decided on a superhet., we can easily add A.V.C. if we wish, and, seeing that this is such a convenience for phone reception and takes so few additional parts to include, it can hardly be left out. For CW reception, A.V.C. is not nearly so desirable, and so arrangements are made to switch in a manual gain control. Since A.V.C. and manual control are not wanted at one and the same time, a change-over switch can be used, eliminating one control.

### (2) Audio Section

Many communication receivers seem to be designed on the principle that "any old audio end will do." While it is true that there is no need for 10 watts output and a high-fidelity audio section, it is important to see that sufficient audio gain is available at all times. This means having enough gain to bring the noise level up to good speaker strength with the aerial terminals short-circuited. This might seem a peculiar thing to specify until it is remembered that sometimes a receiver will be operated under very good conditions. That is to say, there will be little or no QRM or QRN, so that the very weak signal, if present, will not be many decibels above the noise level. Under these conditions, there must be sufficient gain to ensure that the noise level can be amplified up to good speaker volume. If this is not possible, it simply means that the R.F. sensitivity of the set is not being utilized. Thus, if the set noise, which, as we have said, seldom sets the signal-to-noise ratio on account of external noise present can be amplified up to good audibility, we will be sure that the weakest signal which appears above the noise level will be copyable. This point is not so important with phone as it is with C.W., for it is well known that C.W. can be copied at a considerably smaller signal-to-noise ratio than can phone signals. We are thinking, too, of the amateur who is fortunate to live well out in the country, far from many sources of interference which exist to plague city dwellers. Accordingly, a stage of A.F. amplification is used in front of the output stage. A headphone jack is provided at the output of the first audio stage.

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# EIGHT-NATION TELEVISION EXCHANGE

## SUCCESSFUL BROADCASTS AUGUR WELL FOR "EUROVISION"

By HUGH P. BELLANTI

Recently television history was made when viewers in eight countries in Europe were enabled to witness on their TV screens events taking place hundreds of miles away. This international television link provided people in France, Germany, Italy, Holland, Denmark, Belgium, Switzerland, and Britain with a series of about 18 programmes ranging from the battle of flowers at Montreux, in Switzerland, to Glasgow Police Athletics at Ibrox Park Stadium. Royal occasions televised during this "Eurovision" exchange included the golden jubilee review of the Royal Naval Volunteer Reserve by Her Majesty the Queen on Horse Guards Parade, London, and the visit of Queen Juliana of the Netherlands to a garden party for refugee children at Oud Naarden, in Holland.

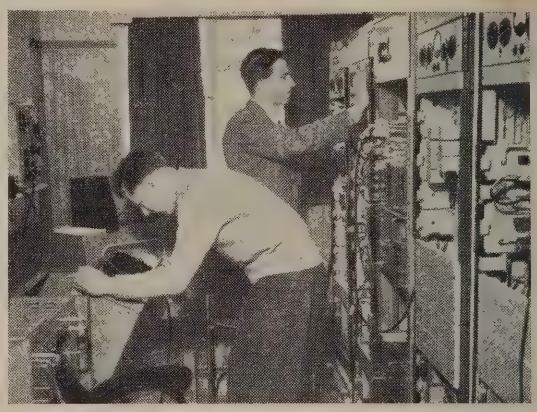
*Standards Conversion Equipment used near Dover during the Eurovision Experiment.*

The success of these television broadcasts across national frontiers is acknowledged as an excellent augury for the future of "Eurovision." It has widened the horizon of television exchange to the whole of Europe. And it is an outstanding achievement by all the engineers and programme staff who made this complicated enterprise feasible.

The part played by British equipment in the success of the Eurovision broadcasts was anything but small. Some £2,000,000 worth of television and radio components was sent to the participating countries by leading manufacturers in Britain. These included Marconi, the General Electric Company, Pye, the Standard Telephone Company, British Insulated Callender Cables, and the Electrical and Musical Industries Ltd.

All the equipment for two studios in Belgium was of British manufacture. Denmark used an Outside Broadcast unit and 4 micro-wavelength apparatuses supplied by British firms. Cables and couplers for cameras and micro-wavelength equipment were sent to Holland and France; camera equipment to Germany.

The Montreux "Fete des Narcisses," which formed part of the inaugural broadcast of the series, was televized from a TV Outside Broadcast vehicle recently



*Some of the equipment at one of the repeater station.*

supplied to the Swiss P.T.T. by Marconi, of Britain. The Mark II Image Orthicon cameras on the van fed the signals to Zurich, whence they were telecast by radio-links to the European nations taking part in the exchange.

The bulk of the equipment used in Italy came from Britain. Mobile cameras of the same type as those at Montreux were used for the programme from Rome during which His Holiness the Pope was seen on the television screens in the homes of the people of eight countries. He delivered a message in five languages.

One of the most important technical aspects of the eight-nation link was embodied in the conversion units supplied by Philips Industries and installed by the British Broadcasting Corporation near Dover. These were used to convert the European standards of transmission to the British 405 lines, and the equipment for them was also of British manufacture.

It is estimated that some 90,000,000 viewers in the eight countries enjoyed the benefit of the "Eurovision" broadcasts. Their success was widely commented on by the British Press. "A new chapter in TV has begun," wrote one of the leading dailies. "The range of events worth viewing which will now become available has vastly increased. It would be too much to say that the new system is likely to promote concord among the nations, but it will increase the sum of knowledge available, and the work of Eurovision should help to make the world a happier place."

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# SAFETY PROCEDURES IN ELECTRONIC EQUIPMENT

*By the Engineering Department, Aerovox Corporation.*

Electric shock and fire are the principal hazards which may accompany the operation of electrical equipment, including electronic apparatus. The first is dangerous to personnel only; the second to personnel, equipment, and surroundings. The causes often are related and sometimes are identical. Safety measures related to electronic equipment accordingly are directed toward reduction of shock and fire hazard.

Varied attitudes exist toward the potential dangers of electronic equipment. In general, the tendency is to pay little attention to such matters when apparatus is manned by skilled persons, and to become concerned only when workers with limited training and experience will be exposed. Unfortunately, a fatal or crippling shock or a destructive fire, either incident blameable to skilled but unalert persons, must occur to point up the need for more attention in this direction. All electronic equipment should be safe, regardless of the calibre of people assigned to its operation and maintenance. The laboratory should be no more hazardous than the assembly-line test position.

Safety measures may be applied effectively in three areas: design, installation, and operation. When apparatus is designed for maximum safety and is installed and operated with due regard to the prevention of shock and fire, maximum freedom from danger usually is obtained. Concentration of precautionary steps in only one area imposes additional responsibility in each of the other two and jeopardizes life and property.

## DESIGNING FOR SAFETY

Safety devices and circuit arrangements can be included in electronic equipment at the design and construction stages. It is easier to build them into such apparatus than to add them later. It is well to survey the common devices of this sort, with a view to their inclusion in a given electronic product.

### Interlock Switch

The interlock switch is one of the oldest electrical safety devices, but strangely is one of the least used in modern equipment. Ordinarily, it is wired in series with one or both of the power-line leads to the electronic power supply unit, and is installed on the lid, cover, or door of the enclosure so as to break the circuit when the enclosure is entered. A true interlock switch is automatic in action. It does not depend upon manual manipulation by the operator.

Multiple interlock switchs, wired in series, may be used for increased safety. Thus, one switch may be installed on the access door of a transmitter, and another on the dust cover of the power supply section.

Complex interlock systems are provided when separate circuits should be opened for safety. An example is the use of separate open-up switches for the A.C. power line and the high-voltage D.C. output of a power supply.

Since electronic equipment often must be serviced "hot," interlock switches must be operable by the responsible personnel when access doors are open. However, they should always be located in such a manner as to make closure difficult and therefore attention-catching.

Interlock switches can be used to advantage on transmitters, oscilloscopes, high-voltage power supplies, photoflash equipment, precipitators, and television receivers.

### Bleeder Resistors

A bleeder resistor is connected permanently across the output terminals of a high-voltage D.C. power supply. As its name implies, its purpose is automatically to bleed the dangerous charges off the filter capacitors.

No medium or high-voltage power supply should be constructed without a bleeder, since high-grade filter capacitors can store murderous charges for long periods of time. The bleeder resistance must be the lowest value which can discharge the capacitors **quickly** without excessive loading after the power has been switched off. In power equipment the resistor is chosen to give a discharge time constant of 1 min.

The bleeder current is an additional load on the power supply, but the system should be designed with this slight additional burden in mind. Good insurance is provided by the automatic charge-draining action of the bleeder resistor.

### Current-limiting Resistor

A current-limiting resistor is an inexpensive safety device in a high-voltage power supply. It should be incorporated in every supply from which potential only, or small currents, will be required. Such a resistor is connected in series with the output, and limits the current to a safe value during short-circuit or accidental contact. A familiar example is the high-resistance (usually 1 megohm) series resistor in R.F.-type D.C. kilovolt power supplies.

### Capacitor-shorting Devices

In some equipment—e.g., high-voltage radar apparatus—where large, high-voltage capacitors must be operated without adequate bleeding, the operator must discharge these capacitors before working on the high-voltage circuits. For this purpose, metallic grounding or shorting rods with insulated handles should be chained inside the equipment within easy reach of the operator. Short-circuiting rods, wands, or bars should be insulated beyond the voltage they will handle, in order to be grasped safely by the operator, and they should be non-removable from the equipment.

Note.—Do not discharge high-voltage capacitors with a low-resistance bar. A large resistor of 200-watt 10,000-ohm rating should be used.

### Meter Protection

Old-style panel meters having metallic zero-set screws should be avoided in electronic equipment. Such setscrews run "hot" in high-voltage circuits and constitute both shock and fire hazards.

Metal-case meters should not be used except on **grounded** metal panels or chassis, since such instruments will, in the event of internal ground or short-circuit, have high potential on their cases and flanges.

For maximum safety, meters in high-voltage circuits should be mounted behind a window of glass or thick plastic.

### A.C.-D.C. Circuitry

Whenever possible, transformer-isolated power supplies should be used in preference to transformerless (A.C.-D.C.) circuits. Although the line-operated supply is simple and compact and furnishes sufficient power for many applications, its negative return is at power-line potential and therefore dangerous.

When there is no choice in the matter, design the circuit so that no connections are made directly to the chassis or metal panel. If the chassis **must** be included in the circuit, mount the completed equipment in a case or cabinet made of insulating material, and use only insulated knobs, dials, and switches.

It is good practice also to polarize the power plug so that the circuit returns always will be connected to the grounded side of the power line.

### Insulated Controls

Use metallic knobs, dials, switches, and levers only in equipment known to be of the "cold-chassis" type. Never use such attachments with A.C.-D.C. devices.

As an added precaution, short setscrews should be used in all insulated knobs, so that the operator's fingers normally will not touch the tops of these screws. When this is not possible, cover the top of each screw with a spot of sealing wax or coil dope, after tightening.

The shafts of rheostats and potentiometers in high-voltage circuits should not be brought out directly to knobs or dials, but should be recessed far enough back of the panel or below the chassis to include an insulated shaft coupling and an ample length of insulated rod. Common examples of high-voltage components of this type are the intensity, focus, and beam-centring controls of an oscilloscope.

### High-voltage Jacks

Jacks occasionally are employed in power circuits for the insertion of meters, keys, output lines, etc. Good practice is to connect such jacks in the grounded B-minus leg of the monitored circuit, rather than that at any point in the B-plus sections.

When this method of connection is not practicable in a particular circuit, however, the jacks should be recessed behind the main panel, where they cannot easily be touched, and clearance holes provided for insertion of the plugs. This will prevent accidental contact by the operator, and also accidental grounding and firing as a result of contact with wires or other metallic objects.

### Switch Firing

Electronic circuits should be designed so as to minimize sparking, arcing, and firing in switches, relays, and similar make-and-break devices. Finished equipment must be inspected fully for verification of the design. In addition to shortening the life of the switching device, firing can create a fire hazard.

Only explosion-proof switching devices should be employed when electrical equipment is to be used in an atmosphere of explosive gas or vapour.

Mercury switches and other mercury-containing devices must be adequately protected against breakage of the glass containers. An additional precaution is to mount a mercury switch in such a location in the equipment that the mercury will not spill on a hot surface **if the container should break.** Mercury vapour is a pronounced health hazard, a factor which must be considered in addition to the electrical mischief which might be caused by the liquid metal on the loose.

### Power-line Safety

Engineers and designers are inclined to confine their safety considerations to high-voltage apparatus. It is important to note, however, that considerable hazard lies in the power-line end of electronic equipment. Fires, bad shocks, and serious burns are known to result from personal contact, short circuit, and grounding at the A.C. line. The danger is heightened when the supply is 220 or 440 volts.

Only line cords bearing Underwriter's Laboratories approval and in good physical condition should be employed. Such cords must pass through grommet-lined holes in chassis or panels, never through raw-edged metal.

Three-conductor line cords should be used whenever facilities are available for using the third wire as an equipment ground.

Adequate fusing of the equipment should be provided. It is a form of negligence to assemble any complete radio or electronic apparatus without including one or more fuses **in the equipment itself.**

### Positioning of High-potential Components

Each component with exposed terminals in medium or high-voltage portions of a circuit should be protected from short-circuit, grounding, or accidental contact by the operator.

Such parts include selenium rectifiers, bleeder resistors, capacitors with exposed terminals, switches, rheostats, and 115-volt pilot lights. Wherever possible, such components should be mounted under the chassis where they are not exposed. However, ventilation requirements do not always permit this. Therefore, when it is impracticable to conceal the components below chassis, protective housings, with ventilating holes or louvres, should be provided. When housings cannot be used, the exposed terminals of the components should be oriented away from the direction of easy contact. These expedients will lessen shock and firing.

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# N.Z. Electronics Institute Inc.

## ANNUAL REPORT

In his annual report, Mr. Harold F. Symmons, Dominion President of the New Zealand Electronics Institute Inc. considered the past year to have been a successful one. It commenced with a great innovation, namely the transfer of Headquarters from Wellington to Dunedin, and though it cannot be said that this transfer was effected without a hitch, the general result has been stimulating. Many lessons have been learned concerning the preparation necessary to ensure future smooth transfers of headquarters machinery, and there is little doubt that, provided care is taken to avoid transfers so frequent as to impair efficiency, the periodic moving of Institute headquarters can have a very invigorating effect on the whole Institute.

Highlight of the year was the formation of the Invercargill Branch, which was approved by Council on 11th March, 1954. For this, full credit must be given to the Dunedin Branch.

In general, recruitment has been satisfactory, though not startling. Council has approved the admission to various grades of 36 new members, and transfers to higher grades have been granted in 7 cases. The 36 new members have been attached to Wellington (7), Christchurch (3), Dunedin and Invercargill (26). Compared with last year's total of 14 new members, this increase is fair, but not good enough. Total financial membership now stands at 140, and if the Institute is to thrive, membership should be increased at the rate of a least 50 a year for the next few years.

The redrafted Constitution now being considered by the Branches should remove a few anomalies and ensure greater clarity. Other important routine matters which have received attention include the establishment of Standing Orders for the conduct of Council business, and procedure for dealing with Institute money by Branch Treasurers. This should ensure a more efficient conduct of Institute affairs.

Much progress has been made towards the clear establishment of the qualifications required for admission to the various grades. Though this matter is entangled with difficulties, it is hoped that it will soon be possible to issue as Appendices to the Constitution, schedules showing clearly the type of qualification required for admission to each grade.

Branches in Wellington, Christchurch and Dunedin have enjoyed interesting meetings regularly throughout the year, and the Invercargill branch looks forward to similar activities next year. The inactivity of the Auckland Branch is a matter of great regret.

Finance has caused the Council some concern during the past year and, though, in future, it seems that the Institute might just be able to pay its way, the Council would like to see the position eased by an increase in membership rather than through the raising of the subscription rates. Unfortunately, however, the latter prospect must be faced unless there is a substantial membership increase.

Mr. Symons reminded members of the Institute's Official Organ, "Radio and Electrical Review," and urged Branches to send reports of their monthly meetings to the Dominion Secretary for publication in this journal. By this means, members could be kept informed of the activities of other Branches, and arrangements might be made whereby interesting lectures given in one Branch could be repeated in another centre, greatly to the benefit of all concerned. In fact, "Radio and Electrical Review" could and should be an important medium through which the cohesion between the various Branches is maintained.

Concluding his report, Mr. Symmons thanked all members of the Council for their support and co-operation during the past year, paid tribute to the work of the Dominion Secretary and other Councillors who had contributed so generously time and energy in efforts to reduce the Institute expenditure, and expressed his appreciation of the work of the Hon. Auditor who had given so much help over and above his normal duties.

# News from the N.Z. Amateur Radio Transmitters' Association

**These notes are supplied by the Publicity Committee of the N.Z.A.R.T., 25 Lees Road, Brynwr, Christchurch, to whom all inquiries should be addressed.**

The recent frequency measuring contest showed that New Zealand amateurs can hold their own with overseas contemporaries. In returning an average deviation of four cycles from the transmitted frequencies, Mr. B. A. Mansell (ZL1AGI) of Opotoki proved his claim to the John McKim Memorial Trophy beyond all doubt. The commercially built section of the contest was won by Mr. K. Bargh (ZL2ACV) of Wellington.

Though some time has elapsed since the Memorial Contest and the results will not be available for a while yet, all indications point to a very close finish. Possibly this may be caused by the change from optional operating periods to a fixed period, which means that all contestants were on the air at the same time. In general, conditions were very poor. Even the East Coast Australians were difficult copy, and it was surprising that the DX worked covered as good a selection as has been heard on 80 metres recently.

Countries worked included U.S.A., Alaska, Samoa, Rarotonga, Macquarrie Island, Norfolk Island and Japan. Surprise of the second night was VK9SP at Port Moresby, who came up some twenty minutes before the contest was due to finish. Needless to say, he had a very busy time.

The High Frequency bands seem to be opening up a little, and, in particular, 21 mc. is giving the odd rare one.

Consistently bad conditions on 80 metres seem to drive more and more amateurs towards V.H.F., and we predict an upsurge of activity in these regions. Much talk centres round the 420 mc. band where there is plenty of scope for both transmitter and receiver. These can be simple and inexpensive but quite efficient, as was demonstrated at a recent lecture to the Christchurch Branch by members of the Ashburton Branch. V.H.F. technique can become absorbing, and in every town there are interested members of the Association who will be only too pleased to assist the newcomer to the V.H.F. bands.

Long range V.H.F. is accomplished only under "freak" conditions, and the more activity we can have on these bands, the greater chance of local records being broken.

Remarks concerning the self sufficiency of the amateur and the little interest he displays in group effort do not apply to members of the Franklin Branch of the Association, which will complete its own clubrooms shortly. In every sense, this project represents co-operative effort from the very beginning.

A section was leased from the local Council, trees were donated by a local amateur, felled by members, carted to a sawmill where voluntary labour converted them to timber of the required sizes. Once the timber had seasoned, building commenced, and has now progressed to the weatherboard stage. On completion of these rooms, the Franklin Branch will possess clubrooms of which it can be justifiably proud, especially as it is one of the smaller branches of the Association. We too, are proud of Franklin.

# COSMOCORD: ACOS CRYSTAL PICK-UPS

*We have pleasure in reprinting hereunder a technical report or Acos Crystal Pick-ups written by Mr. P. Wilson, M.A., and published in the March, 1954, issue of the well-known English Journal, "The Gramophone." Acos products are distributed in New Zealand by DAVID J. REID, 271 Victoria Street West, Auckland, P.O. Box 2360, who will be pleased to supply any further information required.*

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| | |
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| Frequency range ..... | From 20 c.p.s. to 17 k.c.s. |
| Voltage output ..... | Standard 1 volt; LP ⅓ volt. |
| Tracking weight ..... | 8 grms. |
| Stylus ..... ..... ..... | Cantilever-mounted sapphire, but diamond may be had at extra cost. |
| Crystal Unit ..... ..... | Rochelle salt, hermetically sealed. |

My visit to the Cosmocord factory at Enfield was a real eye-opener. I was aware in advance of the clever design of these cartridges, and I may claim to know something about this particular matter, having spent hours and hours myself mounting Rochelle Salt crystals in all sorts of mountings. Having regard to that experience, I took off my hat some three or four years ago to the design of the G.P. 19 cartridge with its cantilever stylus and its embedding in a viscous material in a hermetically sealed cartridge. This design put crystal pick-ups on the map once again.

The improvements incorporated in H.G.P. 39 have made sure that there they are going to stay, and in a commanding position to boot. But, there is one thing producing a good design for a pick-up; it is quite another to repeat that design in thousands. During my visit to the Cosmocord works I saw not only that this was done, but also how it was done. The assembly, of course, is done by girls with delicate and skilful fingers. What intrigued me were the checks that were applied to each cartridge at each stage, by means of ingenious tools. Then, at the end of the line, I saw each cartridge go through a frequency response test by the attachment of a high-quality crystal recording head to the sapphire of the pick-up cartridge and the measurement of the output from the cartridge as tones of different frequency were fed into the recording head. I also saw a large number of response curves plotted from measurements from frequency test records. The tolerances at each check were very small. So, surprisingly enough, were the number of throw-outs, even though the testers were far from generous to faults. In the result, the response curves I observed were as near alike as makes no matter.

What a wonderful achievement!

Now for some details of the pick-ups themselves.

The stylus assembly has a very low mass and the lateral compliance is as much as five times as high as that of G.P.19. This means such a considerable reduction of "needle-point impedance" that tracking of record grooves of large amplitude and difficult curvature has been much facilitated. A tracking weight of 8 grams is ample for all the records I have tried, and there is no stylus noise.

Stylus replacement has been most ingeniously simplified, and can be done by an amateur when necessary—even a clumsy one like myself.

The frequency response of the standard head is very nearly flat up to about 500 c.p.s., and then proceeds to fall at about 3 db. per octave to about 8 kc/s. It then proceeds to rise to a peak at about 11 kc/s., and then falls off rapidly so as to reach the 3 db. falling curve at about 15 kc/s. But, of course, since standard recordings do not go up above about 8 kc/s., the response above that figure can well be cut off by a corrector circuit in the amplifier input. A proper choice of corrector circuit here will do much to cut off scratch without impairing the possible quality of reproduction. I feel that a little research on this point will be worth while as soon as one has time to look into it in detail.

The frequency response of the LP head follows the constant amplitude law apart from a peak at about 11 kc/s. The output from the Decca frequency test record is therefore constant up to about 1,300 c.p.s., and then begins to rise to a peak of about 10 db. above the zero level at 11 kc/s., and comes back to the zero level again at a frequency between 14 and 15 kc/s. If this peak is flattened out electrically, the pick-up has a sensibility flat response to well over 14 kc/s. In my own measurement, I could detect a falling off at the 15 kc/s. frequency, which is the highest recorded on any of my test records. The makers have suggested a provisional corrector circuit which seems to work very well. I was actually using this circuit in the thrilling test I mention above, though I adjusted my continuously variable controls by ear.

The use of the correction circuit reduces the output by more than half, but there is still enough even on LP records to load a good high-gain amplifier.

**PICK-UP HEADS TYPE HG35-1 PRICE 37s. 6d.**

These heads incorporate the same cartridges as the H.G.P.39, and the remarks made above apply here also.

They are of the 3-pin push-in type, and are interchangeable units (Standard and LP) for the Garrard auto-changers, Nos. RC.90 and RC.111, as well as for record-player model TA.

A weight is incorporated in each head so as to counterbalance some of the weight included in the Garrard arm. The net stylus pressure is not more than 10 grams. P.B.A.

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*Tube Data*

# Receiving Valve 6BR7—Part II

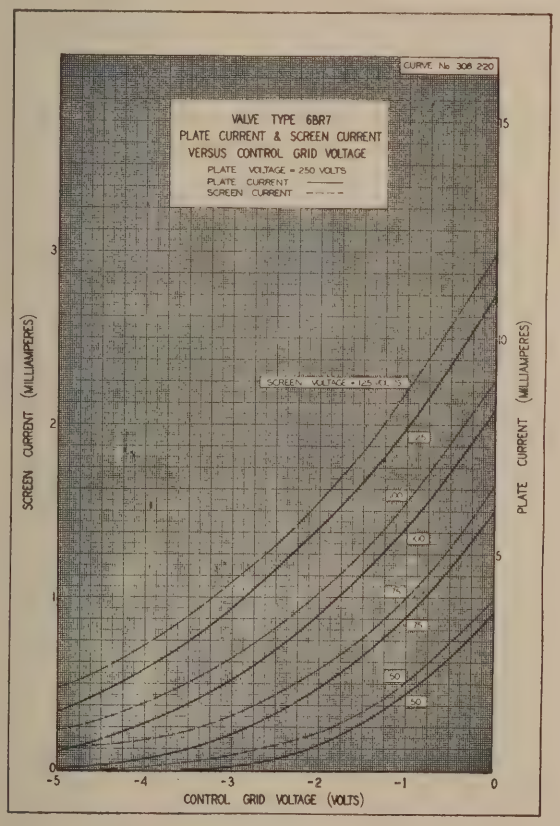
*(Information by courtesy of Brimar. For Part I, refer to "R. & E.," June, 1954)*

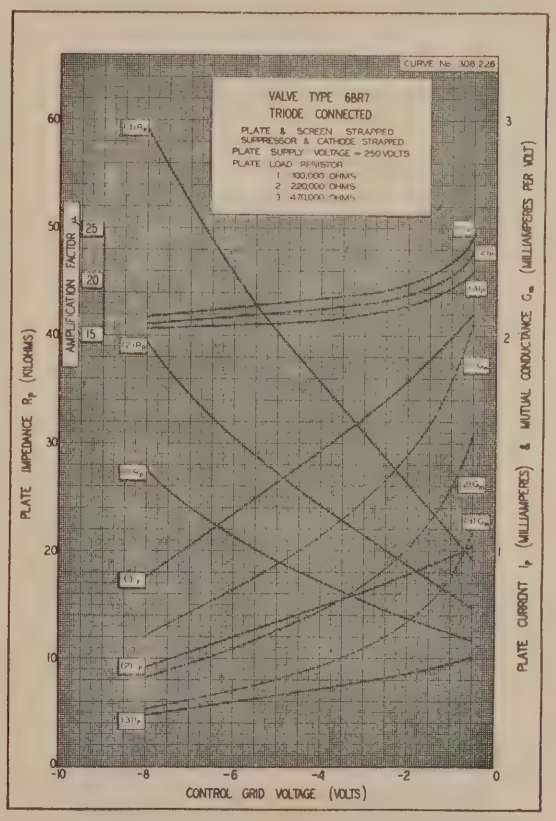
**Triode Connected**

The valve may be used as a low $\mu$ triode resistance-capacity coupled amplifier where the requirements for low hum and noise outweigh these for high gain. In the table below are given typical operating conditions under various conditions of plate load and supply voltage which yield an output with approximately 5% distortion.

| | | | | | | |
|---|---|---|---|---|---|---|
| Plate voltage | 100 | | | 300 | | volts |
| Plate load resistance | 100 | 220 | 470 | 100 | 220 | 470 kΩ |
| Cathode bias resistor | 7.5 | 14.5 | 20.0 | 6.0 | 14.0 | 18.6 kΩ |
| Succeeding stage grid resistor | 0.5 | 1.0 | 1.0 | 0.5 | 1.0 | 1.0 MΩ |
| Peak output voltage | 22 | 26 | 28 | 88 | 96 | 105 volts |
| Stage gain | 12 | 13 | 14 | 13 | 14 | 14 times |

The method for using this curve for calculating performance is as follows. If it is desired to use a plate load of 220 kΩ with a supply of 250 volts, inspection of the curves indicates a reasonably linear portion over the region of grid voltage —2 to —8 volts. Assuming an operating point at —5 volts, the plate impedance and amplification factor are shown as 27.2 kΩ and 17 respectively. The plate load





CURVE No 308 226
VALVE TYPE 6BR7
TRIODE CONNECTED
PLATE & SCREEN STRAPPED
SUPPRESSOR & CATHODE STRAPPED
PLATE SUPPLY VOLTAGE = 250 VOLTS
PLATE LOAD RESISTOR
1 100,000 OHMS
2 220,000 OHMS
3 470,000 OHMS
AMPLIFICATION FACTOR
PLATE IMPEDANCE $R_p$ (KILOHMS)
PLATE CURRENT $I_p$ (MILLIAMPERES) & MUTUAL CONDUCTANCE $G_m$ (MILLIAMPERES PER VOLT)
CONTROL GRID VOLTAGE (VOLTS)

A curve, No. 308.226, is included in the report, which shows the relation between the various valve parameters and control grid voltage under conditions of R.C. coupled operation with various values of plate load resistance.

is effectively in parallel with the following valve grid leak, and if this is 1 MΩ, the effective load is

$$\frac{220 \times 1000}{1220} \text{ or } 180 \text{ k}\Omega.$$

The stage gain is then

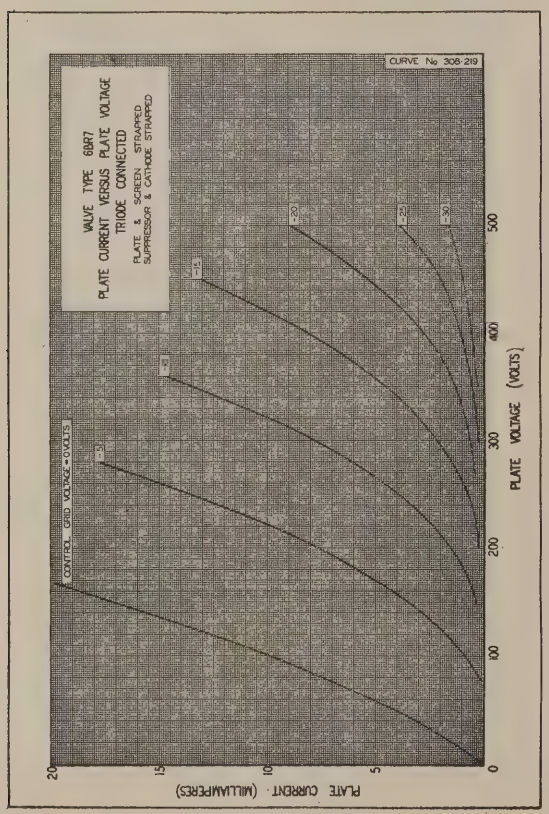
$$\frac{\mu Rp}{Rp + rp} = \frac{17 \times 180}{207.2} \text{ or 14 times.}$$

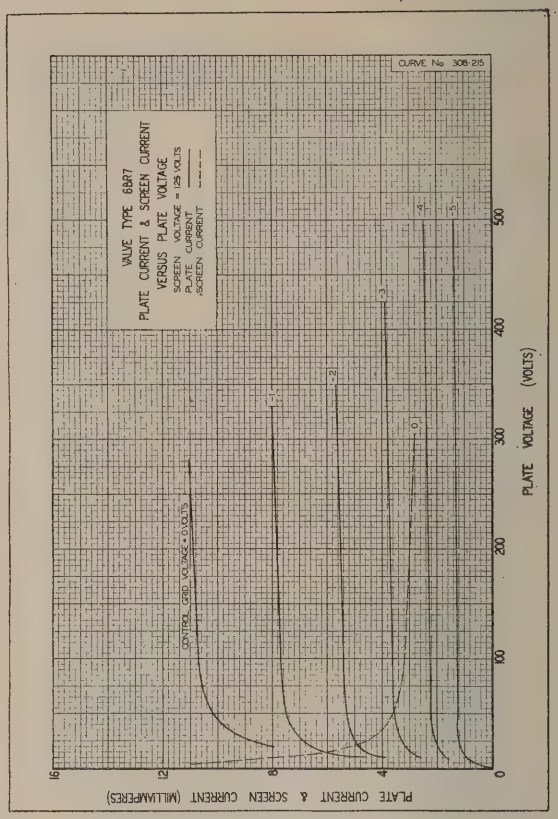
The distortion may be estimated in the same way as for pentode operation by calculating the stage gain at the extremes of the input signal.

### Low Hum Applications

**Pentode Connected.**—Due to the extensive internal screening, very little magnetic and electrostatic hum pick-up occurs in the electrode structure. The single-ended construction, however, admits the introduction of hum voltages through the capacity and leakage between control grid and heater-leads in the glass button base and valve holder. The hum pick-up due to this will be dependent on the relative values of grid/cathode circuit impedance and stray impedance between grid and heater. The base leakage, and to some extent the capacity, will be subject to considerable variation from valve to valve due to small impurities in, and oxide films on, the surface of the glass. Assuming one side of the heater is earthed, the peak voltage will be approximately 9 volts between grid and the other side of the heater. If a grid circuit impedance of 100 kΩ is assumed, it will be seen that an effective impedance of $10^{11}$ ohms between grid and heater will introduce nearly 10μV of hum into the grid circuit.

In order to achieve low hum levels from the valve in early stages of an amplifier, precautions must be




taken to see that the valve is not situated in any A.C. fields from chokes, transformers, or heater wiring. Similar precautions must obviously be taken with the input wiring, and decoupling earth returns pertaining to the stage should be returned to a single point and not distributed around the chassis forming closed loops liable to couple with A.C. magnetic fields.

An external screen is not normally necessary for this valve unless it is subject to severe external magnetic fields. A small improvement may be observed if a valve holder with a screening skirt is used, as it provides additional screening where the grid pin enters the base of the valve. A valve holder with low leakage and capacity should be used, and where one side of the heater is earthed, pin 4 should be used for this purpose, so that the live heater pin is remote from the control grid. The cathode bypass condenser should have as high a capacity as possible to reduce the introduction of hum into the cathode circuit by way of heater-cathode capacity and leakage.

A considerable reduction in hum level may be achieved by returning the earth, not to one side of the heater, but to the slider of a low resistance potentiometer connected across the heater terminals. By this means some of the hum introduced by valve base leakage and capacity may be balanced out.

The figures quoted are with a grid resistor of 100 kΩ. Wherever possible the grid circuit impedance should be limited to this order to obtain the lowest hum level. If a higher impedance is used, there is

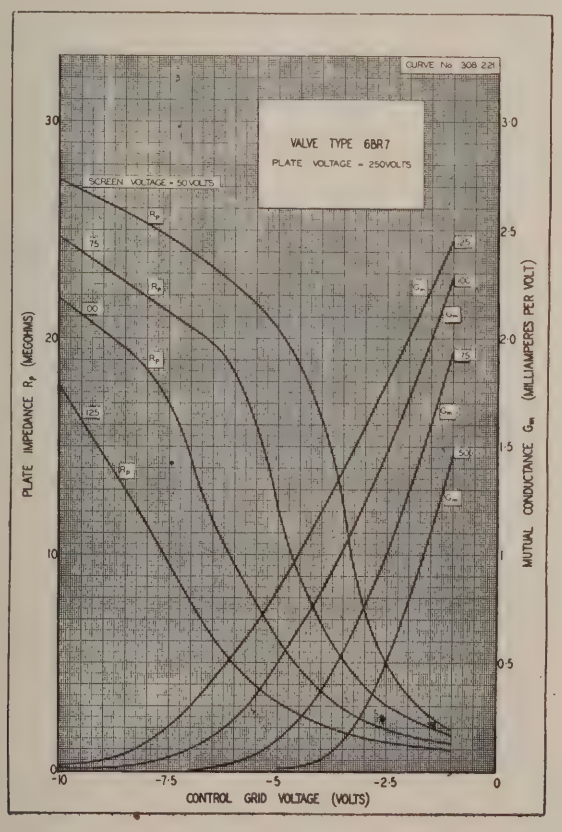
more possibility of electrostatic and leakage pick-up by the grid. In practice, grid resistors up to 5MΩ in value may be used with only a 50% increase in hum level due to internal coupling in the valve.

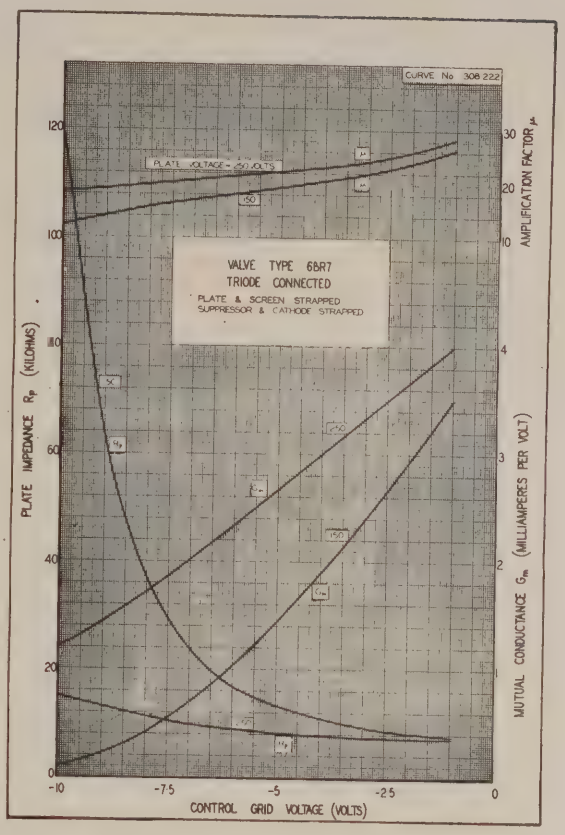
## MICROPHONY

It is not possible to specify the microphony level because this is so much dependent on the circumstances of the application. The valve has been designed with a very rigid structure to minimize the effect of vibration, but there will always be some movement of individual grid wires when vibrated at their resonant frequency. By careful design, all low-frequency resonances due to loose electrodes have been removed, so that there are no internal resonances below 1000 c/s.

It is interesting to note that the amplitude of vibration to produce an acceleration of 2.5g. varies from 0.25 in. at 10 c/s. to approximately 0.001 in. at 150 c/s., while at 5000 c/s the peak amplitude is only two millionths of an inch. Most of the higher frequency vibrations are heavily damped by the chassis and valve holder mounting. The use of an anti-microphonic type of valve holder usually eliminates vibration effects at these frequencies.

Where the valve is being used at the limit of its sensitivity, it is important to minimize as far as possible by flexible valve holder mountings all mechanical and acoustical vibrations. This is particularly important where the valve is included in the same cabinet as the loudspeaker, or a motor such as in magnetic tape recorders and sound-film projectors.




## VALVE SHOT NOISE (HISS)

A certain amount of random noise will be generated in the valve by the random arrival of electrons at the plate, and this is further increased by the partition of the cathode current between plate and screen, as the random collection of electrons by the screen must have its effect as an increased variation in the number of electrons arriving at the anode. This is inherent in the valve, and cannot be entirely eliminated. A major contribution to valve noise, however, is noise produced by leakage between electrodes over the mica insulators and in the base. Also a poorly activated cathode can produce a noise voltage swamping the normal valve noise.

The shot noise in the 6BR7 has been reduced to a minimum by careful design, and the noise due to leakage controlled by careful assembly and inspection. A certain amount of leakage noises is unavoidable in a mass-produced valve, and this reveals itself as a small variation in noise level from valve to valve.

# Circuits for the Experimenter

(Continued from page 29.)

### ERRORS IN FIG. 2

Potentiometer in multivibrator circuit: For 10k read 100k. Grid leak resistor in same circuit: For 3.3k read 3.3 meg.

# Record Talk

By JOHN GRAY

*Editor's Note: We are pleased to announce that this page will from now on be a regular feature of "Radio and Electrical Review." The author of these notes is well known in record circles, and his recommendations are backed by a wealth of experience. We hope that this page will be of much use to both sellers and purchasers of gramophone records.*

The rapidly extending range of available makes now includes Festival records, the appearance of which is of great importance and interest to all classes of record enthusiasts. Details of some of the initial releases appear elsewhere in this issue; classical buyers will be excited to hear that the company has the rights of Vox and Westminster, while in the popular sphere the net has been cast very wide; a number of leading American concerns such as Decca (unconnected with the British firm of the same name) and Coral being among those represented, on this new Festival label. The discs are pressed in Australia and such samples as we have been able to hear reveal a high standard of workmanship.

In addition to LP there are some standard 78s and, most interesting of all, "extended play" 78s, these latter containing two numbers on each side (they are played with the normal pickup head). Among the artists represented are pianist Erroll Garner and the orchestras of Larry Clinton, Jerry Gray and Sy Oliver. A disc containing two operatic arias and two songs from the famed tenor Jan Peerce also appears as an exceptional bargain at the price.

No one needs to be told of the excellence of Westminster records; this American company has long been recognized as a major concern as regards both musical and technical excellence. Most of their performances are by leading European artists and ensembles, and music lovers will find a number of works not otherwise available, such as Gluck's ballet "Don Juan" (WL5028) Tchaikovsky's "Souvenir de Florence" (WL 5083) and Goldmark's violin concerto (WL 5010). From a purely technical point of view the most exciting release is of the "Ilya Mourometz" symphony and "Red Poppy" ballet by the doyen of Russian composers, Reinhold Gliere (WAL 210, 4 sides in all). Gliere is of the romantic school and this music has a good deal in common with that of Rimsky Korsakoff. It is set forth in a truly staggering performance and recording by the Vienna State Opera Orchestra under Hermann Scherchen, a conductor long famous throughout Europe. This is orchestral recording in excelsis.

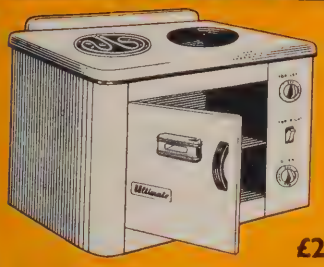
Further 2-record sets of interest include Mahler's fifth symphony plus the adagio from his unfinished tenth (same conductor and orchestra, WAL 207), excerpts from the 1952 International Eisteddfod held at Llangollen, Wales (WAL 209) and a performance of Donizetti's opera "Don Pasquale" recorded in Vienna by an Italian cast (WAL 206). Among the Festival releases originating from Vox masters are one or two concerto performances from our old friend Lili Kraus.

Philips LP classical records may be expected soon; meanwhile some specimens in the popular field have arrived and a healthy range of 78 r.p.m. singles is on sale. Due to their arrangement with American Columbia, Philips are able to release the latest performances by a number of very familiar top-flight popular artists, that brilliant assemblage who, under the expert guidance of Mitch Miller, have almost transformed this particular field. Jo Stafford, Doris Day, Frankie Laine, Guy Mitchell, Paul Weston and many other names are represented on the Philips label. For old time sentiment, you could scarcely do better than sample E21244, whereon the Mariners, with Jimmy Carroll's orchestra, beguile us with "They don't play the piano any more" and "Sentimental Eyes." Among the popular LPs, the irrepressible Liberace with orchestral backing gives us an orgy of his piano antics. The disc is genuinely entertaining and would make an ideal party record (BO7613R). A collection of vintage Duke Ellington may be enjoyed on BO760R, and a substantial piece of jazz history comes to life in the famous Benny Goodman jazz concert at Carnegie Hall (BO7000L and O7007L). Since this was recorded in 1938 you will hardly expect "high fidelity," but in this case few enthusiasts will want to deny themselves the pleasure of having the records.

Last month's crop of releases from His Master's Voice (N.Z.) Ltd. offered an almost embarrassing collection of riches. Music lovers would note a rare bargain in the appearance, on one plum label disc, of the two of the most popular of all piano concertos, the Grieg and the Schumann, the soloist being the ever reliable Moiseivitsch (CLP 1008). From Columbia came no fewer than three issues by Sir Thomas Beecham, the Sibelius symphony No. 1 (33CX 1085) Beethoven's "Eroica" (33CX 1086) and Franck's "Accursed Hunter" coupled with a colourful suite from Rimsky Korsakoff's "Le Coq d'or" (33CX 1087). The Decca issue included an up-to-date, sparkling version of that favourite old ballet, "Giselle" recorded almost complete on one disc by the Paris Opera Orchestra (LXT 2844). "Graduation Ball," a ballet arranged to the music of Johann Strauss, and which incidentally we may hope to see in the next Borovansky season, receives brilliant treatment under Fistoulari on LXT 2848. There is a complete "Pagliacci" starring the sensational tenor Mario del Monaco who, for good measure, contributes a recital of arias on the fourth side of these two well recorded discs (LXT 2845/6).

A number of "Jazz Archive" records released under the London label offers repressings of many performances recorded in the 1920's and long out of print. Included are a number of Fats Waller piano solos (AL 3507) originally made as piano rolls and never previously released in record form.

# ELECTRICAL AND TRADE SECTION



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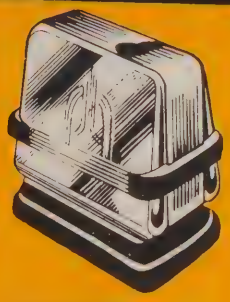

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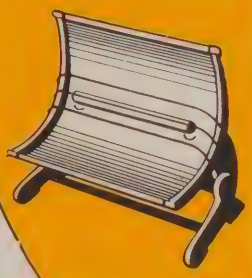

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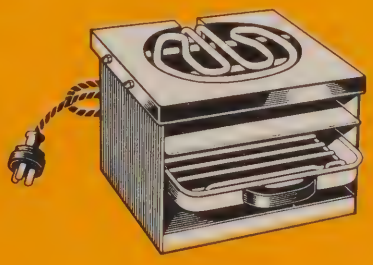

"MINICHEF" COOKER
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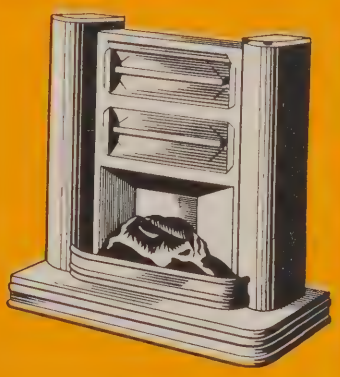

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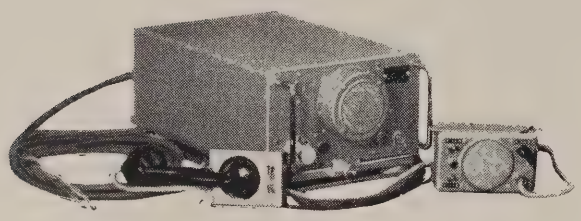
# TWO-WAY RADIO-TELEPHONES FOR PAKISTAN

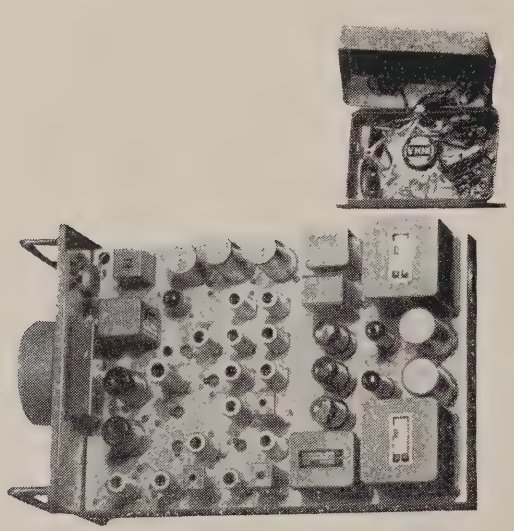


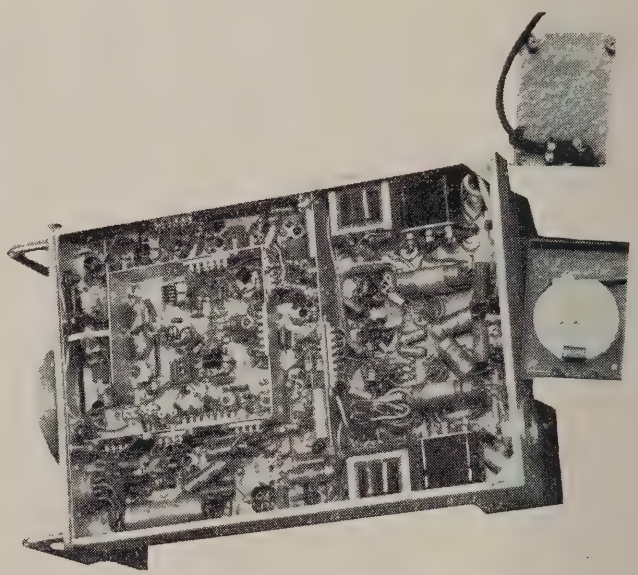
One of the oldest established radio manufacturers in New Zealand is the firm of Collier & Beale Ltd., of Wellington, which has always been in the forefront of technical achievement. A recently completed job of which C. & B. are justifiably proud has been the design and construction of seven base stations and thirteen mobile sets of V.H.F. two-way communication equipment for the New Zealand Government. These sets, which were built to a Post and Telegraph specification of unusual difficulty, are being supplied to the Government of Pakistan as part of our commitments under the Colombo technical aid plan. As we write, the equipment is on its way, and on arrival will be installed by Mr. C. Sturton, of the New Zealand Post and Telegraph Department, on agricultural and earth-moving machinery. It is not difficult to imagine how valuable this equipment will be in co-ordinating and speeding the work of bringing under cultivation considerable tracts of land previously unused for agricultural purposes.

Against stiff opposition this contract was obtained by Messrs. Collier & Beale Ltd., who are to be congratulated both on this and on having met successfully a very tough specification.

## SOME TECHNICAL FEATURES

Electrically, the fundamental difficulties of constructing equipment for a frequency in the region of 75 mc/sec. can no longer be considered great, but the specification in this instance called for some rather unusual features. For example, proper operation had to be ensured under ambient temperature ranging from 14° F. to 125° F. At the same time, battery voltage variation from $-7\frac{1}{2}$ to $+25$ % had to be tolerated by the equipment without reducing the transmitter power output below a given minimum figure, and without exceeding a given maximum, or causing overheating and breakdown. Expressed like this, baldly, the matter is hardly in true perspective with relation to the difficulties involved, and considerable technical resource and ingenuity had to be exercised in order to meet the required conditions. For example, it was found that the oscillator crystals had a disconcerting habit of ceasing to function within a certain small temperature range, and considerable development work was required before a suitable oscillator circuit was devised which enabled the oscillator to remain functioning over the whole range of temperature required.





Another requirement was for extreme compactness in the mobile sets, so that a motor-driven air-blower had to be used. This brought its own set of problems, since provision had to be made for preventing insects from being drawn into the "works" by the blower. The sets had to be completely tropicalized, and this meant the use of special components, specialized impregnation of all transformers, and the use of fungus-repellent varnishes on all the wiring, etc.

One of the most difficult problems was that of securing the specified transmitter output with the

(Continued on page 52.)

# NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

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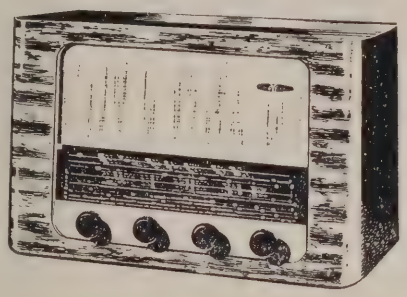
## The New Pye 77



A new Pye model is always an event in the world of radio—and the model 77 is no exception.

The Pye 77 is a 5-valve (including rectifier) 8-wave bandspread superhet for A.C. power operation. The waveband coverage is: Medium Waveband (182-562 metres); Medium Short Waveband (36-97.8 metres); and the 11, 13, 16, 19, 25, and 31 metre-bands Bandspread.

Possible tone variations of Fidelity, Brilliant, Mellow and Speech ensure that Model 77 provides true tone values for all types of radio programme and recorded music. The loudspeaker is of the 6.5 in. P.M. moving coil type, and sockets are provided for an extension speaker of 2-4 ohms impedance; further sockets are provided for any normal type of pick-up, either for Standard 78 r.p.m. or LP records.

The cabinet of the Pye 77, in highly polished walnut, has been specially designed with a slightly sloping front which not only adds to its distinguished appearance but has the practical advantage of making tuning simpler and more accurate. The dial scale is of perspex, edge-lit, with the station names standing out brilliantly against a gold background.

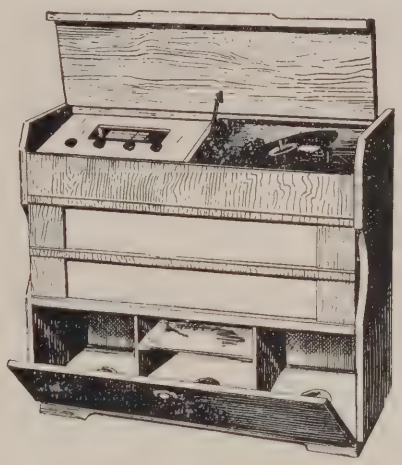
Offered at a retail price of £35 17s. 6d. the Pye model 77 is certain to be a steady profit line. Like all Pye models the 77 is manufactured by the Akrad Radio Corporation Ltd., Waihi, and distributed throughout New Zealand by Pye (New Zealand) Ltd., P.O. Box 2839, Auckland.

## Two Clipper Models

### THE "CLIPPER" Gram 7

G. A. Wooller and Co., Ltd., distributors of the sensational "Clipper" range of radios and radiograms, have now introduced the Clipper Gram 7 (7G4).

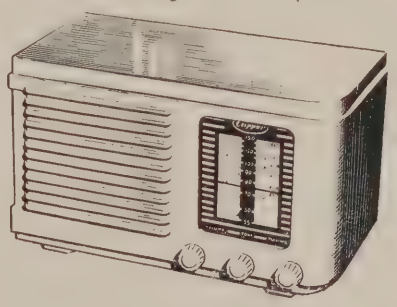
The "Clipper" Gram 7 is a 7-valve luxury radiogram with WIDE RANGE SOUND, but costs only **70 Guineas.** Its reproduction of the full tonal range is amazing—and is entirely due to SOUNDSPREADING, a revolutionary innovation that ensures the best performance of **base and treble at the same time.** SOUNDSPREADING is achieved through a special audio circuit carefully matched to the acoustic properties of the loudspeaker and cabinet.



The Gram 7 incorporates the famous Garrard RC110 three-speed automatic record-changer, which gives a superb record reproduction worthy of this magnificent "Clipper" model. It plays eight 7 in., 10 in. or 12 in. records at 33⅓, 45 or 78 r.p.m. The modern turn-over Crystal Pick-up unit has readily replaceable styli.

The "Clipper" Gram 7 is housed in a solid oak cabinet of striking American design, available in light or dark shades. The lowboy cabinet has exceptional record storage space for stacking flat a large number of 10 in. and 12 in. discs.

### The "CLIPPER" JUNIOR (Model 5M4).



Introducing the "Clipper" Junior (Model 5M4)—the lowest priced radio nationally distributed in New Zealand.

The "Clipper" Junior is a truly remarkable 5-valve radio—it gives a performance comparable with much more expensive models. The 5M4 features improved tone control with On/Off switch, and a moulded

cabinet of modern design available in a choice of three exciting new colours of ivory, walnut and rich burgundy. The retail price—only **14 Guineas.**

While the "Clipper" Junior is ideal as a "first-choice" radio in a small home it is also particularly suitable as a kitchen or bedroom set, and perfect as a gift.

Attractive sales promotion material is available on these two "Clipper" models which are offered to better radio dealers throughout New Zealand. Prices are low but a full dealer margin has been maintained. Inquiries are welcomed by the sole N.Z. Distributors, G. A. Wooller & Co. Ltd., Head Office, Box 2167, Auckland; and Branches at 50 Courtenay Place, Wellington, and 604 Colombo Street, Christchurch.

* * *

# "Herga" Warming Panels

Devised to provide a source of medium-temperature radiant heat, "Herga" Warming Panels have wide application in industrial processes, photographic trade machines, laboratory apparatus, poultry incubators and chick brooders, drying cabinets, greenhouses and seed propagators, frost-protection devices, and office and shop heating. As a form of domestic heating, these panels are particularly safe in bathrooms and nurseries, and are eminently suitable for background heating to supplement coal or bright radiant electric fires.

They give central-heating comfort at negligible installation cost, while running cost is less than the usual forms of electric heating. Panels are fully insulated, absolutely safe under all conditions, indestructible, and breakdowns are virtually impossible.

The "Herga" Panel consists of a specially made heating element embedded in asbestos base resin-bonded material, which is fireproof, shockproof, tough but not brittle, slightly flexible, and may be readily drilled near the edges. Complete with junction box and wall spacers, panels can be supplied either 3/16 in. or ¼ in. thick in two sizes, 16 in. x 22 in. (350 watt) or 16 in. x 11 in. (150 watt).

Terminal inserts are provided on the panel surface near the lower edge and have a terminal cover suitable for flexible cable. The fitting of a thermostatic control at small extra cost, would further increase comfort and reduce running cost.

Panels can be painted on site with heat-resisting paint or distemper to match surrounding, or can be supplied stove-enamelled cream. Other colours or wood finishes to special order can be supplied.

Manufactured in England, "Herga" Electric Warming Panels are distributed in New Zealand by A. R. Harris Co. Ltd., P. O. Box 1007, 74-76 Manchester Street, Christchurch, who will be glad to welcome all inquiries.

* * *

# The B.T.H. Model 411 Cleaner

A lightweight but sturdy electric cleaner by B.T.H. is now available from electrical dealers. Retailing at £17 5s., this cleaner has new and exclusive features that will make it a best seller as a household aid.

Greater efficiency is assured, due to an exclusive design of dust-bag with a special inner sleeve. This non-clogging bag means less frequent emptying, and the nap-lined fabric also prevents the issue of fine dust.

Compact, for use under low furniture, the B.T.H. 411 is also self-adjusting to the carpet pile, and is an efficient cleaner of linoleum.

An "on-off" foot-pedal switch is easily operated by the tip of the toe. Positioned bristles and searching revolving brush remove surface dust and extract introdden dirt.

Attachments, which include a dusting nozzle, upholstery brush, cornice nozzle, and extension arm, are available as extras for an additional £4 2s. 6d. New Zealand Agents for B.T.H. are the National Electrical and Engineering Co. Ltd.

# World-famous Festival Recordings

## FIRST RELEASE IN NEW ZEALAND

In the early part of August, G. A. Wooller & Co. Ltd. announced the first release in New Zealand of the famous FESTIVAL, WESTMINSTER and VOX recordings including the sensational new Festival 78 r.p.m. EXTENDED PLAY discs.

**FESTIVAL RECORDINGS** include pressings from the original recordings of the following outstanding studios:

DECCA Inc., U.S.A.; CORAL Record Inc., U.S.A.; BRUNSWICK Radio Corp., U.S.A.; Record Corporation of America (RCA), U.S.A.; SAVOY; REGENT; BELL; METRONOME, Sweden.

Originals of these recordings by air mail mean that pressings can be released in the fastest possible time —right up in line with hit parades.

**WORLD-FAMOUS CLASSICS.** G. A. Wooller and Company have also released, again for the first time in New Zealand, the famous high-fidelity long-playing WESTMINSTER and VOX catalogues of classics. As is well known, WESTMINSTER recordings have long been acclaimed by the world's critics for their technical excellence. For the last three years Westminster has won the "Oscar" of the recording world—Grand Prix du Disque, Paris. Westminster also holds the Audio Engineering Awards for Symphonic Recording and for Folk Singing Recording, and the Downbeat Awards for Piano Recording and for Vocal Recording.

**EXTENDED PLAY 78 r.p.m.** Another New Zealand first is G. A. Wooller & Co. Ltd's. release of extended play 78 r.p.m. discs—two full length numbers on **each** ed play 78 r.p.m. discs—two full length numbers on each side of a 78 r.p.m.—made possible by Festival's unique process. One can visualise what this will mean to the thousands of record fans whose player units are the old style single speed 78.

**TOP LINE PERFORMERS.** To give an idea of the talent offering, here are some of the names included in Festival, Westminster and Vox catalogues: Frankie LAINE, Ella FITZGERALD, DORSEY Brothers, Hazel SCOTT, Kay STARR, Louis ARMSTRONG, Charles LAUGHTON, Cary GRANT, Lili KRAUS, Noel COWARD, Jimmy DURANTE, Marion ANDERSON, Duke ELLINGTON, Harry JAMES, Elizabeth SCHUMANN, EILEEN JOYCE, London Philharmonic, Vienna Symphony, Vienna State Opera, Royal Opera House, Covent Garden, and hundreds of others.

**ALL THIS ADDS UP** to something really big. Famous labels from leading recording studios **plus** the cream of the world's performers **plus** classics, evergreens and pops **plus** standard 78, extended play

78, and long play 33⅓! This is something that all record dealers can well be enthusiastic about—and there's more to come yet. What G. A. Wooller & Co. Ltd. are offering is matched by the way they offer it—by price and by selling policy. Selling policy is truly liberal and full details will be supplied on application to G. A. Wooller & Co. Ltd., P.O. Box 2167, Auckland.

SELLING POLICY:

(1) **SPEEDY RELEASE** of American Hits: Hit parade numbers will be on sale with a speed never before seen in this country.

(2) **EXTENDED PLAY 78 r.p.m.:** Exclusive to Wooller dealers.

(3) **LIBRARY PARCELS:** Add £10 to £15 and more to the value of radiogram sales.

(4) **FREEDOM to reduce price of pops 3 months after release. No loading down with dead stock.**

(5) **FREEDOM to stock other labels:** G. A. Wooller & Co. Ltd. welcome competition.

(6) **FREEDOM to use old titles for sales promotion:** No restriction on the use of records to push along radiogram sales. The more radiograms sold, the more records sold.

(7) **STRONG PLUGGING of new releases:** On hit parades and sponsored programmes, in advertising and special features, the public will be hearing more and more about the labels of G. A. Wooller & Co. Ltd., their artists and their titles.

This is really big news for the record business. A first-class range and a reasonable policy make excellent opportunities for all dealers.

Sole New Zealand distributors for Festival, Westminster and Vox recordings: G. A. Wooller & Co. Ltd., Head Office, P.O. Box 2167, Auckland.

Branches at 50 Courtenay Place, Wellington, and 604 Colombo Street, Christchurch.

* * *

# B.T.H. Electric Washing Machine

Immensely popular in Great Britain, and with many thousands of users throughout the world, the B.T.H. Washing Machine is currently available in New Zealand. With its electrically driven safety wringer, large-capacity bowl, and efficient performance, the B.T.H. machine has no equal for home laundry work.

Distinctive features include a washing capacity of 11½ gallons, pressed-aluminium octagonal bowl with enamelled cover top, rounded corners and curved edges throughout, resiliently-mounted ½ h.p. B.T.H. motor, drive mechanism and bowl—ensuring quiet, vibrationless operation. A special storage compartment in the cabinet houses the wringer when not in use.

Cabinet dimensions (approx.): Height, 34in.; width, 22 in.; depth, 22 in.

Retail price of the B.T.H. Washing Machine is £75, and sole New Zealand Agents are the National Electrical and Engineering Co. Ltd.

**BINDERS FOR "R. & E."**
**These are available to hold 12 issues—price 5s. 6d.**

# Notes from the N.Z. Radio and Electrical Traders' Federation

**These notes are supplied by the N.Z. Radio and Electrical Traders' Federation to whose Secretary, P.O. Box 322, Wellington, all correspondence and inquiries concerning same should be addressed.**

## GROUP BUYING

There has been considerable Press comment, particularly by retailers, on the question of certain groups who are buying and are securing a preferred rate. Obviously, there must be two sides to this question, otherwise the group-buying schemes would not have come into existence. One school of thought is that, in the initial stages, a limited number of retailers were getting extra business because of the inducement offered. Now that the scheme has wider ramifications, this particular benefit is greatly reduced. Others may claim that this business is cash business, and sacrificing a percentage of the retail selling price is justified.

On many occasions, members of Radio Traders' Associations ask, "What have we to discuss?" Surely the above question is one which is worthy of discussion by radio traders.

## WANGANUI ASSOCIATION

The well-attended annual general meeting of the Wanganui Radio and Electrical Traders' Association took place on July 14, when members were delighted to welcome the Federation President, Mr. N. Souper, who expressed his appreciation of Wanganui's kind invitation.

Much time was occupied in discussing matters arising from the annual general meeting of the Federation, and members were glad to hear from Mr. Souper an explanation of the position concerning registration of radio servicemen. Mr. Souper stressed the need for unregistered but qualified personnel to apply for registration as soon as possible. The position of apprentices in the industry was also explained to members.

Mr. W. Cannons was re-elected President for the ensuing year, and at the conclusion of the meeting members were entertained at an informal supper party.

## WELLINGTON ASSOCIATION

At the annual general meeting of the Wellington Radio and Electrical Traders' Association, held on August 3, Mr. N. J. Hallett, the President, when presenting his annual report, remarked on the buoyancy of the past year for radio and electrical dealers. Commenting on the satisfactory membership strength, Mr. Hallett reminded members of the aims of the Association and of the encouragement given to the executive by well-attended meetings.

After giving a brief resume of the proceedings of the recent annual conference of the Federation, Mr. Hallett reported that the Wellington Apprenticeship Committee was meeting regularly every month, and recommended that members spare no efforts to encourage apprentices, who will be the radio technicians and servicemen of the future.

(Concluded on page 52.)

# RADIO AND ELECTRICAL APPLIANCE MARKETING

BY W. L. YOUNG

Display is one of the most important features of any business. Particularly is this so, however, as far as radio and electrical appliances are concerned. Any radio or electrical appliance which is purchased must serve two purposes in the home: it must be useful, but it is also equally important that it blends in with the general home setting. Correct display enhances appearance and increases eye-appeal, thus stimulating the desire to buy. A would-be purchaser who is favourably impressed with the appearance of an article is prompted to inquire further, and desire to purchase increases accordingly.

*Window display featuring vacuum cleaners. Particularly note that only one type of appliance is shown, but numerous features are emphasized by individual cards.*

The matter of display quite frequently is associated rather too narrowly with window or shop display. The issue, however, is broader than this. Even the best of pictures will suffer if it is not in the correct frame, or, worse still, in a frame which does not do justice to the picture.

The frame which encompasses a window or a shops display obviously is the outside appearance of the building and the surrounds of the windows. Now, not every shopkeeper is blessed with the latest shop front or the most modern of buildings. Even with the older type of building, much can be done at little expense to improve the outward appearance of a building or window surround.

A fault that is common to a number of businesses is to renovate their premises or provide new signs and then leave these until they are absolutely disreputable. The cost of repainting signs, etc., on the front of any building is not very great, particularly as in quite a number of instances advertising signs can be incorporated. Many distributors are only too happy to make a substantial contribution towards the painting of such signs, featuring their lines, because they are mutually useful to the retailer and the distributor. A retailer must, however, bear in mind the fact that it is his business, and the name he trades under should be the most prominent sign on his building or shop front. On the matter of lines which can be featured on signs, naturally the retailer should give consideration to lines on which he has sole rights or there is a limited franchise.

Coupled with the appearance of the building is the necessity for adequate window lighting, and any display to be effective must be properly illuminated. Therefore, make the most of the existing lighting facilities, and in any alterations you may be considering make generous provision for normal lighting, spot lighting, and concealed power sockets which will provide for either additional lighting or illuminating some radio or appliance. The correct location of power points also simplifies the installation of moving or animated displays, which are more arresting than stationary objects. Adequate power points also allow connections without straggling wires. There are certain types of appliances which incorporate light, such as electrical fires, and in such cases the lights in these appliances should be illuminated.

We have indicated some steps to smarten up the premises and have considered the provision of adequate lighting, so that we now arrive at the question of what should be shown and how it should be shown. At the outset, we wish to make it clear that window dressing is a specially skilled art, developed after years of practice and effort. Therefore, it is not the purpose of this article to endeavour to make a competent window-dresser out of the reader in a matter of minutes. The aim is to endeavour to eliminate the more glaring mistakes, and, if this can be done, much will be achieved.

There are two types of window display: one where the window is an individual unit and is usually cut off from the shop by some form of partitioning; the other is where the window forms part and parcel of the shop, and while there is a special display in the window the observer has an opportunity of taking in articles which may be displayed in the shop rather than in the window. With either type of display it is important that the window proper should be really attractive, because, if the window itself is not attractive, the passerby will not stop and your display remains unnoticed. The most important thing to avoid in any window display is over-crowding—that is, showing too many different articles. Many well-intentioned retailers frequently pack their windows

with such a variety of goods that all prospects of an effective display are lost.

In general, it can be taken that the smaller the number of items on display the more punch will that display have. Taking radio as an example, if there is a radio display, then all the types of radio sets could well be shown; possibly more than one of the smaller sets, to give the display balance. However, in such a display there should be nothing else. The odd torch, battery, electric clock, electric iron, etc., detract from the main display rather than supplement it. In the complete range of any large radio manufacturer, there should be some set which will catch the eye of the passerby; whereas, if amongst these radio sets is anything and everything, the confused assortment ceases to be striking. While on the subject of radio, and to emphasize the importance of limiting displays, with some new release, it could be even desirable to show one single type of set with appropriate showcards to indicate its special features. One very effective way of doing this is to have streamers coming from the point of interest to appropriate discs or plaques, either suspended or attached to the window. Some of the features which come to mind are "special miniature tubes," "twin tone control," "high-fidelity pick-up," "three-speed record changer," etc.

On the matter of features, because a trader is closely associated with, say, radio, he takes for granted many things which are quite new to the retail purchaser. If, as the result of a display such as we have mentioned, a prospect goes in and asks what are miniature tubes? What are their advantages? What is a high-fidelity pick-up? What are its advantages? your sales staff has an opportunity of starting to talk to the prospect and get him really interested, and, after all is said and done, the more prospects you get the more people you have interested, and the greater will be your volume of business. It is with a view to expanding the volume of business that attractive window displays are featured.

Dealing with the matter of appliance display: the writer recalls a very attractive vacuum cleaner display where the hoses of the cleaners were formed to make notes of music, and the appropriate black and white lines were behind the vacuum cleaner hoses. The caption was, "STRIKES A NEW NOTE IN CLEANLINESS." Now, if the cleaners had been mixed up amongst numerous other articles, they would have been lost, but, as they were displayed, the cleaner and the name of the cleaner impressed the viewer immediately, and the type of display was something a little away from the ordinary.

Colours should be well chosen when making a display; they should not clash and should give a harmonious setting to the articles being displayed. Remember, also, that colours, etc., are merely the background, and the choice should be such as to throw into relief the centre piece or the main items of interest.

Many firms are known for their attractive window displays, and, in certain cases, people are on the lookout to see what will be displayed next. The important thing here, of course, is to see that displays are changed regularly, and to have a programme and adhere to it. No window display should stay in longer than a fortnight. This regular changing of articles on display serves several purposes. First and foremost, it means that there is always something new on display. Then there is the fact that in the space of 14 days the display does not get an opportunity to become really bedraggled. Slight dusting may be necessary, but, in general terms, it will remain quite bright for the period of a fortnight. An important point, and this will be of real interest to those people who bemoan the fact that the practice of putting everything in the window has been frowned on, is that regular changing allows a wider variety of merchandise to be displayed. Each display will, of course, be attractive, and 26 displays in a year will allow a wide variety of merchandise to be shown.

Shops which have windows which form part and parcel of the shop proper should display goods in such a way that it is possible to see into the shop—in other words, there must be some gaps between taller items to allow the passerby to see right into the shop. There is also the fact that where shops form a continuation of window displays such shops should be reasonably illuminated, particularly in the front portion. At night, a person looking in through the window will see nothing if the window itself is brightly lit and the background dark or dimly lit.

The reader may say, "Well, I do most of those things," and in quite a number of cases this is true. However, if a careful record is kept of the number of times your window display is changed, how many different types of merchandise are shown at one time, and how much care is taken with each individual display, the records would show that quite a lot more could be done by the average radio and electrical dealer. Your window serves you 24 hours a day, seven days a week. Many retailers give much thought to a newspaper advertisement which at the most occupies a few square inches and which will probably be disposed of after one day. Surely, then, this silent servant is worthy of the fullest consideration. Whether you make full use of your display windows or not, the overhead cost is the same. Why not make an extra effort and put in displays which will be of real value to you and will build up not only the prestige of your business but also your turnover and profit?

Our next article will link sales promotion with servicing. This should be some consolation to our technical friends who may, up to the moment, have considered that undue emphasis was being placed on straight-out marketing, and the value of the servicing department in promoting sales had been entirely overlooked.

**BACK NUMBERS OF "R. & E."**
Available from our Office,
P.O. Box 8022, Wellington.

**NOW—A BETTER, FASTER, MORE COMPLETE SERVICE TO THE RADIO AND ELECTRICAL DEALER**

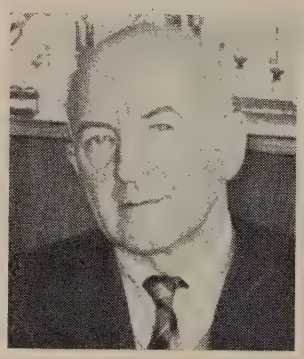
**RADIO PARTS, VALVES, TRANSFORMERS, SPEAKERS, RECORD-PLAYING EQUIPMENT, ELECTRICAL APPLIANCES, and FITTINGS, Etc.**

**LEADING MANUFACTURERS REPRESENTED—CHECK WITH US FIRST—PROMPT DELIVERY TO ANY TOWN OR CITY IN NEW ZEALAND**

**S. C. DAVISON LTD.**
**WHOLESALERS & IMPORTERS,**
**P.O. Box 279 — Palmerston North — 323A Main St.**

# TRADE WINDS

## PHILIPS COMMERCIAL MANAGER ON VISIT TO BRITAIN AND HOLLAND



Leaving Wellington by air on 27th August, Mr. Ralph Slade, commercial manager of Philips Electrical Industries of New Zealand Ltd., spent a few busy days in Sydney before proceeding on his way to Britain and Holland on a business trip which will occupy several months.

After visiting various Philips organizations in Holland and making periodic trips to London, Mr. Slade is expected back in New Zealand towards the end of the year.

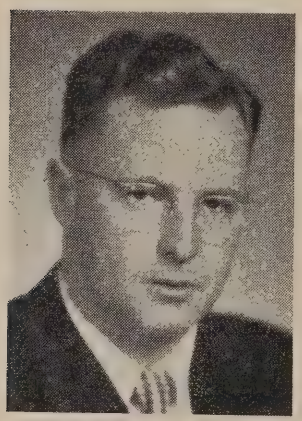
## NEW MANAGER FOR AUCKLAND BRANCH OF SWAN ELECTRIC CO. LTD.

Congratulations to Mr. R. A. Harrington on his appointment as manager of the Auckland branch of the Swan Electric Co. Ltd.

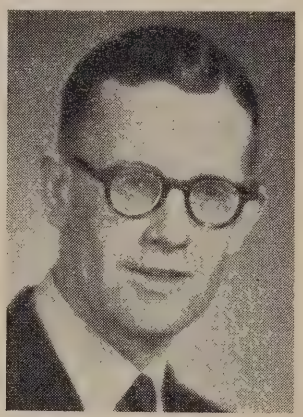
* * *

## G. A. WOOLLER & CO. LTD—NEW CHRISTCHURCH OFFICE

A new branch office for G. A. Wooller & Co. Ltd. was recently opened in Christchurch, with Mr. C. A. Moore as branch manager.



Brian Brailsford



Jack Walch

The new offices at 604 Colombo Street are in a completely new building, and a large showroom provides an excellent setting for displays of "Pacific" and "Regent" Radios, "Sunbeam" Mixmaster and Shavemaster, "Crosley" Shelvador Refrigerators, "Autocrat" Car Radios, "Flyer" Tricycles, and "Festival" recordings.

Colin Moore, the new branch manager, has of course, been South Island representative for G. A. Wooller & Co. Ltd. for many years. Mr. Moore started his business career as a salesman for Stevens & Sons Ltd. in Christchurch, joining G. A. Wooller & Co. Ltd. in 1946 as its South Island representative, after being demobilized.

Able assistance on the sales staff of the Christchurch office is provided by Mr. Noel Bateman, one of many comparative newcomers to the Wooller organization. Noel joined G. A. Wooller & Co. Ltd. in April, 1954. From 1945 to 1953 he was with Swan Electric Co., and had risen to the position of South Island Sales Manager before he left to join Bradley Electrical Co. Ltd.

With its own branch in Christchurch, G. A. Wooller & Co. Ltd. will have the opportunity to provide an even wider service to dealers right throughout the South Island.

* * *

## CHANGE OF ADDRESS: GILES & ELLIOTT LTD.

Messrs. Giles & Elliott Limited, the well-known Wellington electrical firm, has now moved to more spacious premises at 56 Tory Street, Wellington, where it extends a friendly welcome to all clients.

* * *

## BACK IN NEW ZEALAND

Mr. T. J. F. Spencer, Managing Director of the Akrad Radio Corporation Ltd. and a Director of Pye (New Zealand) Ltd., recently arrived back from an extensive business visit to England and the United States.

Mr. Spencer said he found trade very buoyant in England, with a new spirit of confidence, which he attributes to the removal of rationing.

Mr. Spencer was impressed by television, both in England and in America. He described the programmes as "first-class," and commented on the improvement noticeable in the programme material in the 12 months since his last visit.

Noel Bateman

Colin Moore

## JACK WALCH JOINS WOOLLER-PYE GROUP

The very rapid expansion of the companies under Mr. George Wooller's control has of late necessitated many additions to staff, both in Auckland and in the Wellington and Christchurch branches. Not the least of the new appointments has been the advent of Mr. J. Walch as Sales Promotion Manager and assistant to Mr. Wooller.

In England, Jack Walch had 20 years' experience in multiple retail stores with the two largest radio, electrical, and cycle companies there before leaving for New Zealand in 1949. In 1950 Jack joined Bond & Bond in control of buying and sales promotion of radio, and was associated with the rapid rise of Bond & Bond as the largest radio and appliance retailers in New Zealand.

The Wooller-Pye executive team in Auckland is certainly very powerful in experience. With Ray Fitt as Sales Manager for Wooller products, Bert Staff as Sales Manager for Pye, and Jack Walch responsible for sales promotion in all departments, George Wooller seems set for a period of intensive development.

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## ANOTHER NEW ADDITION

Another new addition to the sales team at G. A. Wooller & Co. Ltd. is Mr. Brian Brailsford, who, we hear, is being employed chiefly on specialized selling. His first task with the Wooller organization has been concerned with the promotion of the newly-released "Festival" recordings. Brian Brailsford will be "on the road" again shortly with other lines that will be of interest to all in the radio and electrical trade.

Brian Brailsford has had wide experience in wholesale commercial life. For the past five years he has been with Bradleys Electrical Co., where he started as South Island representative and was later promoted to Sales Manager.

* * *

## EXTENSION OF ALLUM ELECTRICAL CO. LTD'S. ACTIVITIES

That well-known wholesale electrical and radio firm, the Allum Electrical Co. Ltd., already established at Auckland, Wellington, Christchurch, and Dunedin, has further enlarged its activities by opening a branch at Hamilton.

Full stocks are carried at the new address, and the electrical and radio trades in the Waikato are assured of prompt deliveries of all the company's agency lines, including Allen West switchgear; Brown Boveri, Scott, Normand & Fracmo motors; Reyrolle plugs and sockets; Glovers cables; Vidaflex insulating sleevings; Kanthal resistance alloys; A.B. radio switchgear and potentiometers; Gilford resistances; R. & A. speakers; U.A. car aerials; University meters, and, in fact, all equipment normally stocked in the other centres.

A feature of particular interest to the electrical trade is the immediate availability of carbon brushes. These are manufactured in the Auckland carbon brush department, and the Hamilton store has stocks of all types in common demand.

The address is 15 Liverpool Street, the box number 801, and the telephone number 41-385.

# A Neat Display

*Corner of showroom in Christchurch office of G. A. Wooller & Co. Ltd.*

* * *

## PHILIPS SECRETARY RETIRES AFTER 27 YEARS' SERVICE

*Mr. Leighton Lord, Managing Director of Philips, wishes Mr. McNeil a happy retirement.*

After 27 years of service as secretary to the company, Mr. F. C. McNeil retired from the staff of Philips Electrical Industries of New Zealand Limited in July. The occasion was marked by a largely-attended farewell gathering of staff members, when high tributes were paid to his long service by the Managing Director of Philips, Mr. L. Lord, and others.

As the company's first secretary, Mr. McNeil was really part of Philips, as he witnessed the growth of the organization from very small beginnings, when the staff could be counted on one hand, to the present-day New Zealand-wide concern employing some hundreds of people. His well-earned retirement will be spent in Auckland.

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## AUSTRALIAN TRIPS: BUSINESSMEN KEEP IN TOUCH

Typical of the close contact these days between Australian and New Zealand businessmen was a recent plane-load from Whenuapai to Mascot, Sydney.

(Continued on page 53.)

# FOR THE TECHNICIAN

## G.E.C. ELECTRIC CLEANER TYPE DM 370

### SERVICE INSTRUCTIONS

**Works Test Figures**

Water Gauge, belt off, 14 in min.: 170 watts maximum
Water Gauge, belt on, 11in min.: 200 watts maximum
Test on open orifice 250 watts maximum.
Flash Test at 1,000 volts.
Insulation resistance, 2 megohms (new machine).
Insulation resistance, 1 megohm (used machine).

| Windings | 100/10v. ohms | 200/10v. ohms | 220/30v. ohms | 240/50v. ohms |
|---|---|---|---|---|
| Armature resistance between brushes | 2.8 | 10 | 13.6 | 17.8 |
| Field coils (two in series .. .. | 2 | 10.6 | 10.6 | 11 |

Tolerance: plus or minus 7½ per cent.

Colour code on motor casing for voltage identification:

| | |
|---|---|
| Black spot ..... ..... ..... | 100/110 volts |
| Red spot ..... ..... ..... ..... | 200/10 volts |
| White spot ..... ..... ..... | 220/30 volts |
| Blue spot ..... ..... ..... | 240/50 volts |

**Radio Suppression Condensers**

Two condensers are mounted in motor.
1 Part No. 3560 Capacitor 0.005 + 0.005 μf. 250v.
1 Part No. 3556 Capacitor 0.15 μf. 250v.
See sectional drawing for connections.

**Earthing**

The motor is mounted on rubber, and earth connection between motor and casing is made with a metal strip from commutator mounting clamp to the condenser fixing clip. The connection to the earth screw inside pole near switch is made through trunnion hinge pins and metal pole in trunnion.

**Carbon Brushes**

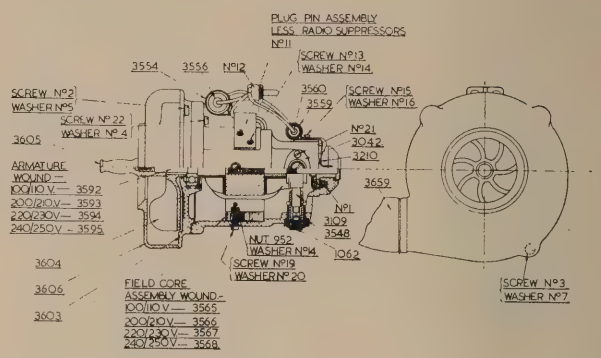
These are of limit travel type to prevent spring making contact with commutator should carbons be completely worn away. It is not possible to remove carbons without first removing motor from casing.

**Motor and Suction Unit**

The motor and suction arrangement is a complete unit resiliently mounted in the cleaner casing by means of a metal clamp and two screws at the commutator end. The suction fan end of the motor is centred on a conical shaped rubber ring held on a projection inside cleaner casing. The connection between suction chamber and dust bag union is by a shaped rubber moulding, rectangular at the chamber end and circular at dust bag. Motor bearings are ball-bearings at driving end and sleeve oil retaining bearing metal bush at the commutator end. These bearings are amply lubricated on assembly and should not require further lubricant for some years.

**Self-adjusting nozzle**

The bottom plate is hinged and spring loaded so that the nozzle of the cleaner bears on the carpet with




a load of approximately 2 lb. The lowest position of the nozzle gives a clearance of 1/16 in. to a flat surface.

**Wheels**

These are bushed with oil-retainmg bearing metal and should be given a spot of oil when the cleaner is serviced.

**Revolving Brush**

The brush rotates in self-aligning bushes of oil-retaining bearing metal and should be given a spot of oil when cleaner is serviced. The bushes are mounted in adjustable brackets to take up the wear on the bristles. The bristles in the revolving brush should not project more than 1/16 in. below the guard.

**Dust Bag**

A longer dust valve is fitted inside bag and is supported to side of bag by means of a tape.

### DISMANTLING INSTRUCTIONS

(1) Remove dust bag off bayonet pins and pull out socket connector on top of casing. Take out screw at bottom of pole and remove pole off trunnion; replace screw in key.

(2) Remove front cover plate by pulling forward top of casting and slip belt off pulley.

(3) Move trunnion down over rear of cleaner and remove the four screws holding the rear half of baseplate to the casing on the underside of the cleaner. The hinged baseplate will then come away complete with trunnion and wheels.

(4) Slip out spring band inside exhaust outlet and remove two screws from clamp at commutator end of motor; also remove clamp. Motor and fan unit can now be removed bodily, complete with rubber coupling, by lifting commutator end of assembly clear of carriage casting, and at the same time easing rubber coupling from exhaust outlet.

(5) Spring the revolving brush guard plate off studs in casing as illustrated on instruction card.

## INSTRUCTIONS TO DISMANTLE MOTOR UNIT

(1) Unscrew carbon brush caps and remove brushes.

(2) Remove shaped rubber coupling from exhaust outlet.

(3) Take out 4 cheesehead screws holding motor frame to front bearing plate and carefully tap suction casing off motor frame spigot, leaving armature in position.

(4) Take 3 screws holding chamber casting to front bearing plate. Suction chamber may then be tapped off, breaking the sealing compound on the machined face. When re-assembling, be sure CSK screw is inserted in countersunk hole.

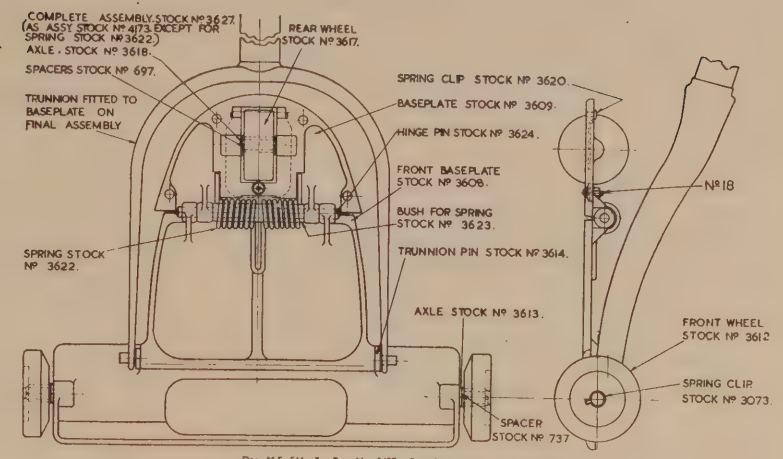
(5) Holding the armature in such a way as to prevent damage, unscrew pulley on shaft (left-hand thread) by using a $\frac{1}{4}$ in. spanner and draw suction fan off shaft.

(6) Tap pulley end of shaft (taking care not to damage threaded portion) through front bearing plate.

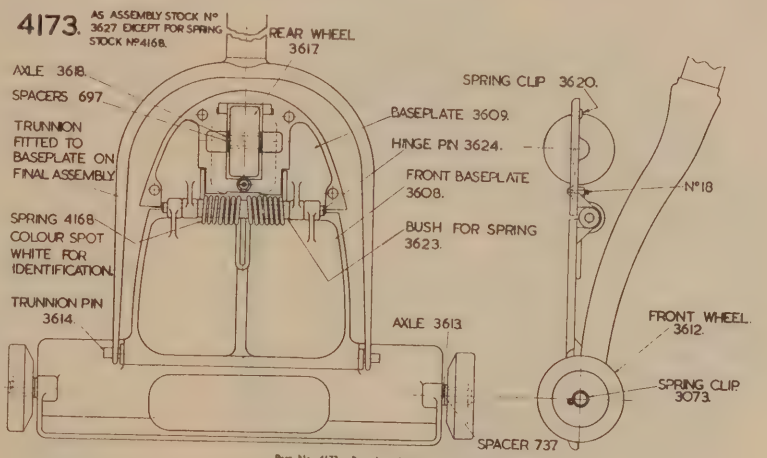
(7) Remove circlip holding ball-bearing in housing with a circlip tool, and press out ball-bearing from housing. (Note position of spring-loading washer.)

(8) To remove field system from motor frame, first unsolder connections on plug pins, slip off spring connectors on brush tubes, and take out the small bolts through motor frame and laminations. Slide out field assembly.

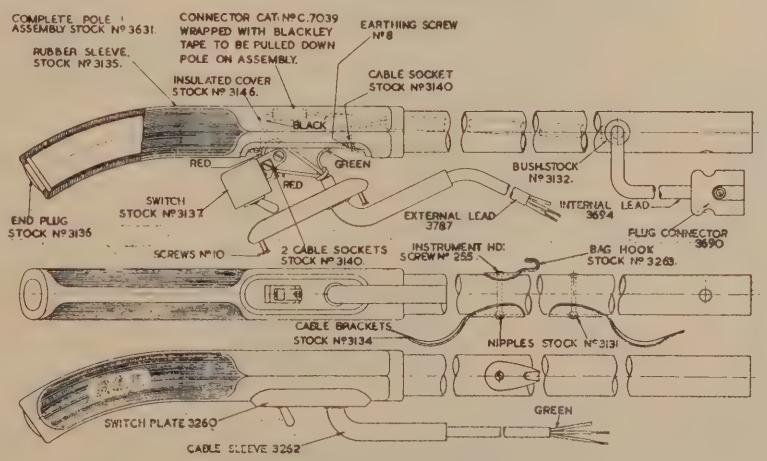
(9) The bearing bush in the motor frame should not be removed. This bush is of oil-retaining bearing metal, and, to ensure that same is true in diameter and in line with the frame spigot, it is assembled in a special fixture, with correct fitting and sizing pins. The oil-soaked pads in the housing are held in position by metal caps which are sealed to prevent oil leakage.


COMPLETE ASSEMBLY STOCK Nº 3627 (AS ASSY STOCK Nº 4173 EXCEPT FOR SPRING STOCK Nº 3622.)
AXLE . STOCK Nº 3618.
SPACERS STOCK Nº 697.
TRUNNION FITTED TO BASEPLATE ON FINAL ASSEMBLY
REAR WHEEL STOCK Nº 3617.
SPRING CLIP STOCK Nº 3620.
BASEPLATE STOCK Nº 3609.
HINGE PIN STOCK Nº 3624.
FRONT BASEPLATE STOCK Nº 3608.
BUSH FOR SPRING STOCK Nº 3623.
SPRING STOCK Nº 3622.
TRUNNION PIN STOCK Nº 3614.
AXLE STOCK Nº 3613.
Nº18
FRONT WHEEL STOCK Nº 3612
SPRING CLIP STOCK Nº 3073.
SPACER STOCK Nº 737

Drg. M.F. 516 - 8. Part No. 3627. Baseplate Assembly with Trunnion.
G.E.C. Cleaner D.M. 370 (Gravity Die Cast Models).




Part No. 4173. Baseplate Assembly with Trunnion.
G.E.C. Cleaner D.M. 3708 (Pressure Die Cast Models).
Drg. Nº. 945-8.




Drg. M.F. 925 - 8. Part No. 3631. Handle Assembly.
G.E.C. Cleaners D.M. 370 and D.M. 3708.

# R/T for Pakistan

(From page 42.)

6-volt battery, which powers the whole equipment, down as far as 5.5 volts. In practice, this meant using a pair of valves in parallel as the final R.F. amplifier, where one of the same type would have met a less stringent specification.

A very high order of receiver sensitivity was called for by the specification, and this was handsomely exceeded by the final design. Such features as muting of the receiver noise at a pre-set signal level, and effective noise limiting were included; in addition, a somewhat peculiar-shaped A.F. response was called for in the modulator of the transmitter. This latter was obtained, not without difficulty, by the use of unconventional coupling circuits between audio stages, and a twin-T network which was included to give the response a sharp cut-out at 10,000 c/sec.

In a short article of this kind, it is difficult to give an idea of the many design features that a specialized piece of equipment like this must have. Suffice it to say that in this job and its successful achievement, we have yet another instance of the versatility and sound technical background of New Zealand's radio manufacturing industry, of which Collier & Beale forms so distinguished a part.

# N.Z. Radio Traders' Federation

(From page 48.)

The financial statement revealed the Association to be in a sound position, and the election of officers resulted as follows: President (re-elected), Mr. N. J. Hallett; Executive—Messrs. W. L. Young, Fowler, Brown, and Wiseman; secretary-treasurer, Mr. C. W. Archibald; auditors, Gordon Berry & Tait; delegate to executive of New Zealand Radio Traders' Federation, Mr. N. J. Hallet delegates to General Meeting of N.Z. Radio Traders' Federation Messrs. N. J. Hallett and W. L. Young.

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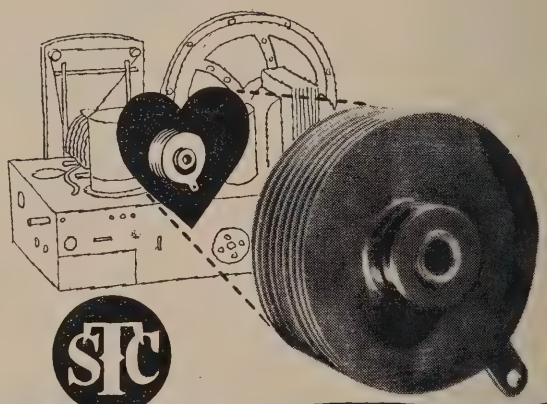

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# TRADE WINDS

(Continued from page 49).

Those on board included George Wooller, Managing Director of G. A. Wooller & Co. Ltd. and of Pye (New Zealand) Ltd.; Jack Shacklock, of H. E. Shacklock Ltd., Dunedin; John Scott, of J. and A.P. Scott Ltd., Dunedin; Ted Grant, of Waihi, Chief Engineer of Pye (New Zealand) Ltd.; R. Robson, of Kirkby Robson, Pye dealers in Hawera; Dan Yuill, Manager of the hardware division of the Farmers' Trading Co. Ltd., Auckland; Don Alexander, Manager of the radio-appliance division of Farmers', Auckland; Ray Fitt, Sales Manager of G. A. Wooller & Co. Ltd.; Keith Doyle, General Manager of James S. McAlpine Ltd., Auckland; Keith Coe, Director of Bond & Bond, Ltd., Auckland.

Several of the visitors toured the new plant of Sunbeam Corporation (for whom G. A. Wooller & Co. Ltd. are co-distributors in New Zealand) at Campsie, New South Wales—by far the biggest and most modern plant of its type in the Southern Hemisphere. With this plant in operation, Sunbeam now have five acres of manufacturing space! There was much interest in the range of new appliances being prepared for release by Sunbeam in addition to their well-known Mixmaster and Shavemaster. First of these is the automatic cooker and deep-fryer, which has had such success in the States and was released in Australia for the first time in July.

Another point of interest was the plant of James N. Kirby Pty. Ltd. Kirbys, who are Australia's largest manufacturers of refrigeration, are licensees and manufacturers for Crosley Corporation, Cincinnati, U.S.A., and G. A. Wooller & Co. Ltd. are their New Zealand representatives. Kirbys have recently opened a magnificent new factory at Enfield, New South Wales. At this and other Australian plants they are manufacturing Crosley Shelvador refrigerators and freezers, Crosley air conditioners, Kirby water coolers, dehumidifiers, and many other products.

John Scott, of course, is well known for his Scott washer, for which G. A. Wooller & Co. Ltd. are North Island distributors. Scotts will soon be manufacturing in Dunedin the big-selling American Whirlpool washer, about which more will be heard soon.

It was on this visit to Australia that George Wooller and Ray Fitt negotiated arrangements for the supply of "Festival" records, which are reported elsewhere in this issue.

## NEECO BALL

The Majestic Cabaret, Willis Street, Wellington, will be the scene of the annual Neeco Ball, which is to be held on Friday, 10th September. There will be a floor show and lots of fun for all, and the staff of National Electrical and Engineering Co. Ltd. extends a cordial invitation to all old and new friends to join with them in making this a gala occasion. Tickets, 35s. double or 17s. 6d. single, are available from Neeco's road representatives or from Mr. P. B. Tucker, of the Wellington office.

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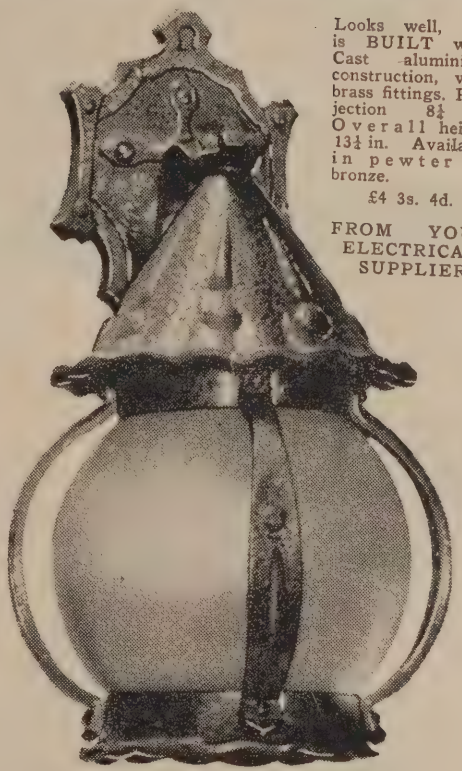

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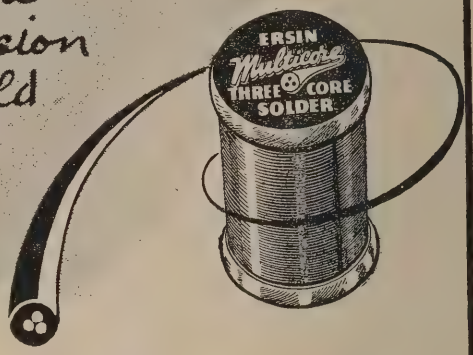


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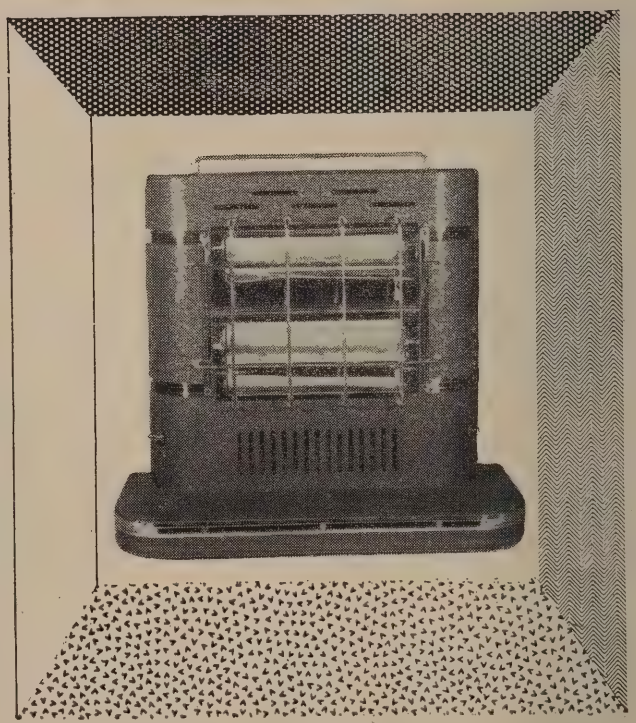

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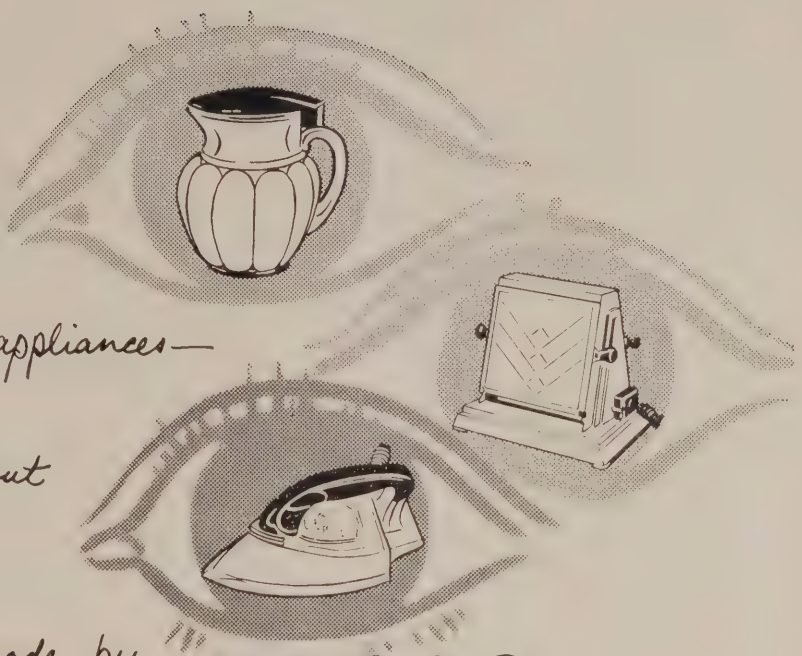

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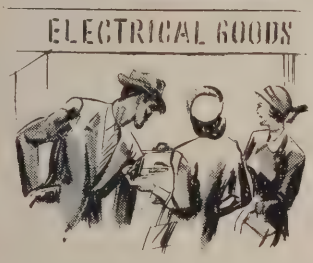


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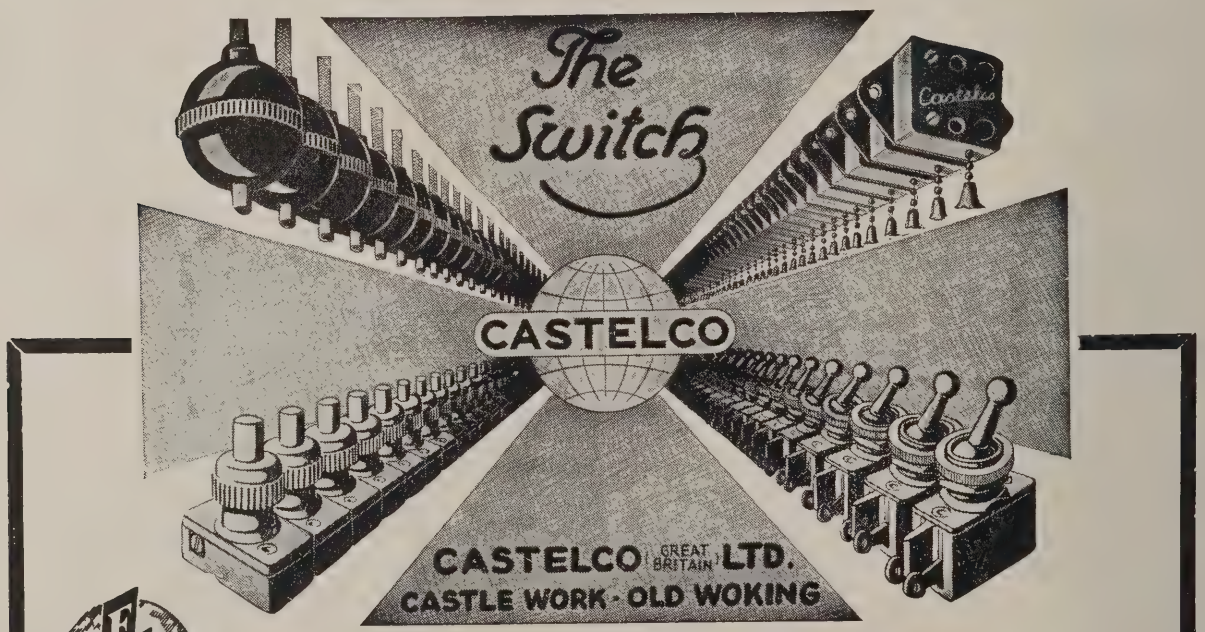


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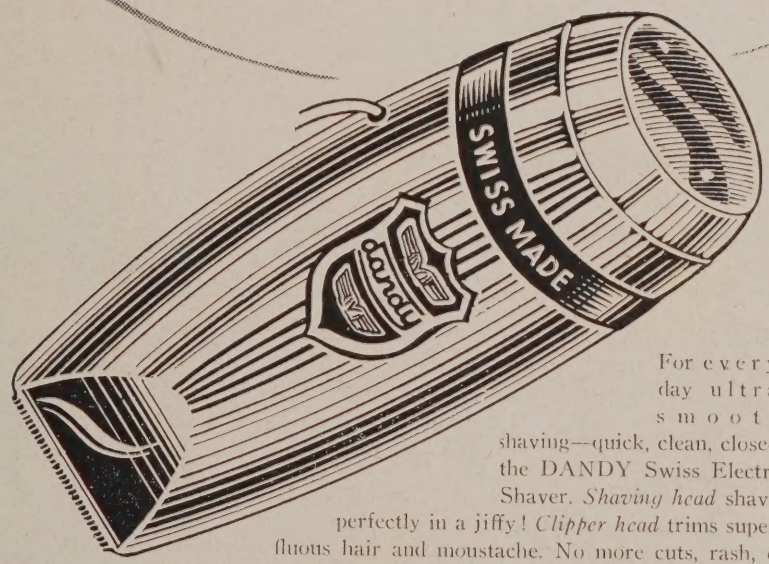


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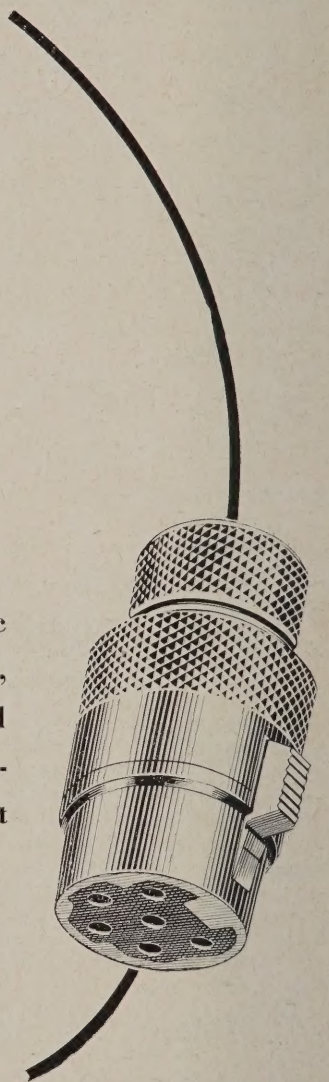

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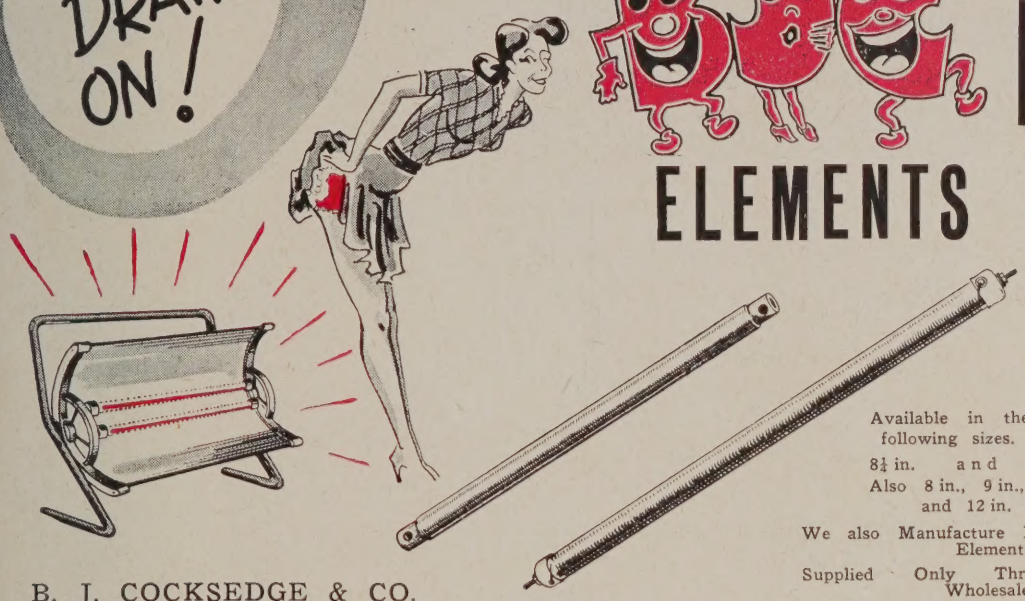

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